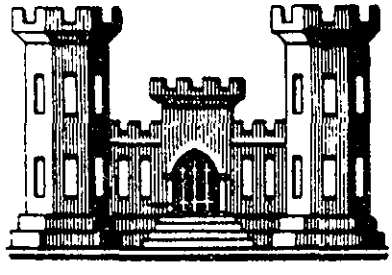
HOUSATONIC RIVER FLOOD CONTROL

ANSONIA - DERBY
LOCAL PROTECTION

NAUGATUCK RIVER, CONNECTICUT

DESIGN MEMORANDUM NO.6

EMBANKMENTS, FOUNDATIONS AND CHANNEL IMPROVEMENTS



U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS WALTHAM, MASS.

FEBRUARY 1966

U. S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASS. 02154

ADDRESS REPLY TO:
DIVISION ENGINEER

REFER TO FILE NO. NEDED-D

28 February 1966

SUBJECT: Ansonia-Derby Local Protection Project, Naugatuck River, Connecticut - Design Memorandum No. 6 - Embankments, Foundations and Channel Improvements

TO: Chief of Engineers
ATTN: ENGCW-E

There is submitted herewith, for review and approval, Design Memorandum No. 6, Embankments, Foundations and Channel Improvements, for the Ansonia-Derby Local Protection Project, Housatonic River Basin, in accordance with EM 1110-2-1150.

FOR THE DIVISION ENGINEER:

JOHN Wm. LESLIE
Chief, Engineering Division

Incl (10 cys)
Des Memo No. 6

FLOOD CONTROL PROJECT

ANSONIA-DERBY LOCAL PROTECTION PROJECT
NAUGATUCK RIVER
HOUSATONIC RIVER BASIN
CONNECTICUT

DESIGN MEMORANDA INDEX

No.	Title	Date Submitted	Date Approved
1	Hydrology and Interior Drainage	30 Apr 65	16 Jun 65
2	Omitted		
3	General Design and Site Geology	14 Jan 66	
4	Concrete Materials	16 Feb 66	
5	Omitted		
6	Embankments, Foundations and Channel Improvements	28 Feb 66	
7	Detailed Design of Structures		
8	Pumping Stations		
9	Hydraulic Analysis		

ANSONIA-DERBY LOCAL PROTECTION PROJECT

NAUGATUCK RIVER, CONNECTICUT

DESIGN MEMORANDUM NO. 6

EMBANKMENTS, FOUNDATIONS AND CHANNEL IMPROVEMENTS

CONTENTS

LIST OF PLATES

PLATE NO.	TITLE
6-1	General Plan
6-2	General Plan of Foundation Explorations
6-3	Plan - Left Bank Stations 0+10 to 7+65
6-4	Plan - Left Bank Stations 7+65 to 23+40
6-5	Plan - Left Bank and Right Bank Ansonia Mfg. Stations 23+40 to 29+30 (Left Bank) Stations 0+30 to 17+50 (Ansonia Mfg. Co.)
6-6	Plan - Left Bank Stations 29+30 to 43+20
6-7	Plan - Left Bank Stations 43+20 to 47+20
6-8	Plan - Left Bank Stations 47+20 to 61+30
6-9	Plan - Left and Right Banks Stations 61+30 to 70+15 (Left Bank) Stations 0+50 to 11+35 (Right Bank)
6-10	Plan - Left and Right Banks and Beaver Brook Stations 70+15 to 82+85 (Left Bank) Stations 11+35 to 24+30 (Right Bank) Stations 26+70 to 31+20 (Beaver Brook)
6-11	Plan - Right Bank Stations 24+30 to 34+30
6-12	Plan - Right Bank Stations 34+30 to 43+56
6-13	Plan - Right Bank Stations 43+56 to 54+80
6-14	Plan - Beaver Brook Stations 1+05 to 11+70

LIST OF PLATES Continued.

PLATE NO.	TITLE
6-15	Plan - Beaver Brook Stations 11+70 to 26+70
6-16	Selected Test Data Foundation - Left Bank
6-17	Selected Test Data Foundation - Right Bank
6-18	Selected Test Data Foundation - Right Bank Ansonia Mfg.
6-19	Selected Test Data Foundation - Beaver Brook
6-20	Engineering Log Profile - Right Bank Stations 0+00 to 40+00
6-21	Engineering Log Profile - Right Bank Stations 40+00 to 55+00
6-22	Engineering Log Profile - Left Bank Stations 0+00 to 39+00
6-23	Engineering Log Profile - Left Bank Stations 39+00 to 81+00
6-24	Engineering Log Profile - Right Bank Ansonia Mfg. Stations 0+00 to 30+00
6-25	Engineering Log Profile - Beaver Brook Stations 0+00 to 30+00
6-26	Plan and Engineering Logs of Borrow Explorations
6-27	Selected Test Data - Impervious Borrow Materials
6-28	Typical Dike Sections Right Bank

LIST OF PLATES Continued.

PLATE NO.	TITLE
6-29	Typical Dike Sections Left Bank, Beaver Brook and Ansonia Mfg.
6-30	Summary of Stability Analyses Left Bank
6-31	Summary of Stability Analyses Right Bank
6-32	Typical Stability Analyses Construction Condition, Circle C-2 Left Bank
6-33	Typical Stability Analyses Sudden Drawdown Condition, Circle D-4 Left Bank
6-34	Typical Stability Analyses Construction Condition, Circle C-3 Right Bank
6-35	Typical Stability Analyses Sudden Drawdown Condition, Circle D-1 Right Bank
6-36	Materials Usage Chart

APPENDICES

APPENDIX	TITLE
A	Summary of Laboratory Test Results
B	Current Cost Estimate

DEPARTMENT OF THE ARMY
New England Division, Corps of Engineers

ANSONIA-DERBY LOCAL PROTECTION PROJECT
NAUGATUCK RIVER, CONNECTICUT

DESIGN MEMORANDUM NO. 6

EMBANKMENTS, FOUNDATIONS AND CHANNEL IMPROVEMENTS

A. INTRODUCTION

1. Location and Description of Project. - The Ansonia-Derby Local Protection Project is located in the cities of Ansonia and Derby, Connecticut, approximately two miles upstream from the confluence of the Naugatuck and Housatonic Rivers in New Haven County, Connecticut. Ansonia and Derby are about 10 air miles west of New Haven, 35 miles southeast of Hartford, and 10 miles north of Long Island Sound. The purpose of this project is to provide improvements which will prevent flooding of commercial and residential property by overflow of the Naugatuck River and Beaver Brook. Improvements will include dikes and walls along the right and left banks of the Naugatuck River, dikes, conduits and walls along Beaver Brook, and excavations for channel improvements for both Naugatuck River and Beaver Brook. The locations, arrangements and pertinent details of the structures are shown on Plates 6-1 and 6-3 thru 6-15.

2. General. - The purpose of this memorandum is to present the analyses and results of soils and engineering design studies and the results of subsurface investigations made for the designs of the dikes and concrete structures, and for determining the character and quantities of materials to be excavated. The subsurface investigations included geological studies, subsurface explorations, classification of materials and laboratory tests. Soils and engineering studies were made to assist in the development of the designs of structures and to develop adequate dike embankments utilizing earth materials from required and borrow excavations and earth and rock materials available from sources in the vicinity of the project. The detailed results of geological studies are presented in Design Memorandum No. 3 "GENERAL DESIGN AND SITE GEOLOGY."

B. SUBSURFACE INVESTIGATIONS

3. Subsurface Explorations. - Subsurface explorations were laid out and made in conformance with current criteria and practices as described in the pertinent sections of the Engineering Manual for

Civil Works Construction. Subsurface explorations made in conjunction with the survey report studies were limited to the excavation of five test pits and one test trench. Additional soil information included foundation boring records for highway bridges. Explorations for final design studies in the foundation areas of all structures and embankments and in areas of channel improvements are nearly completed. Explorations are now in progress in one area to locate a suitable borrow area for impervious fill material. The majority of the explorations were drive sample borings with the remainder being machine-excavated test trenches and hand auger borings. The test trenches were excavated to determine the character and extent of man-made fills. The subsurface exploration program for foundations and materials to be excavated is considered adequate for design purposes and construction control. The locations of all subsurface explorations completed prior to February 11, 1966, pertinent to the project, are shown on Plates 6-2 through 6-15. Foundation and earth borrow explorations completed to date total 104 drill holes, 3 auger holes and 8 test trenches. Explorations not completed, consist of about 10 foundation borings, 10 earth borrow borings and 3 earth borrow test trenches.

4. Laboratory Tests. - All laboratory tests were performed in accordance with current standard procedures as described in the Engineering Manual for Civil Works Construction and other publications of the Corps of Engineers. All soil samples were classified visually in conformance with the Unified Soil Classification System. Grain size analyses, Atterberg Limit determinations and tests for organic contents were performed on selected samples to confirm visual classifications and to provide more precise data where considered necessary. Natural water contents were determined for selected samples of fine grained soils. Shear, consolidation and permeability tests were not performed on foundation or embankment materials, since these characteristics can be judged with sufficient accuracy by visual inspection of the materials, their grain size distribution curves, and from experience with similar materials. After selection of a borrow area for impervious fill material, laboratory compaction tests will be made on selected samples from the area.

5. Presentation of Data. - Tables showing laboratory soil test results and summaries of these results are presented in Appendix A. Test data, pertinent for soils in certain foundation and excavation areas, are shown on Plates 6-16 through 6-19. Available test data, pertinent for soils in the area now being explored for impervious fill material are shown on Plate 6-27. Plates of "Record of Foundation Explorations", completed prior to December 1965, are shown in Design Memorandum No. 3, "GENERAL DESIGN AND SITE GEOLOGY."

These plates will be revised to include explorations made after December 1965, for inclusion in the contract drawings. Profiles, based on engineering logs, are shown on Plates 6-20 through 6-25. These engineering soil logs were prepared for all explorations by the designing soils engineer with the aid of test data and an experienced classifier. These logs include descriptions of the soils and soil strata based on the engineer's examination of the samples and his interpretation of all test results and exploration data. The descriptions include the state or consistency of the material, estimated or tested percentages of the soil components, color, effective sizes, Atterberg Limits, details regarding stratifications, existence of foreign material, geological names, and other data considered significant to aid in judging the characteristics of the materials.

C. CHARACTERISTICS OF DIKE AND WALL FOUNDATION MATERIALS

6. Distribution and Description of Materials. - a. General. - A general description of the characteristics of the foundation soils for the dike and wall structures is presented herein. The distribution of the overburden materials in the dike and wall foundation areas is shown by the engineering log profiles on Plates 6-20 through 6-25.

b. Left Bank - Naugatuck River.

(1) Station 0+10 to 21+00 (Dike and Flood Wall). - The overburden materials in the foundation areas of the dike and floodwall in this reach consist essentially of man-made granular fills that overlie natural deposits of granular soils. The overburden is in excess of 30 feet thick except in the higher foundation area at the extreme northeast end of the dike alignment where bedrock occurs at a depth of 25.6 feet. The man-made fills are generally 15 to 20 feet thick and consist of loose to moderately compact, gravelly silty sand (SM) silty sandy gravel (GM and GP-GM), and sandy gravel (GP), all of which contain numerous cobbles and very minor percentages of cinders, ashes and brick fragments. The deposit of natural granular soil extends to a depth of at least 30 feet, and consists of moderately compact to compact, silty and gravelly silty sand (SM), silty sandy gravel (GM) and sandy gravel (GP). The gravel content ranges from 0 to 65 percent and the silt contents range from 10 to 20 percent, by weight of the component passing the No. 4 Sieve.

(2) Station 21+00 to 33+90 (Flood Wall). - The overburden materials in the foundation area of the floodwall in this reach consist essentially of surficial man-made fills overlying a

natural deposit of firm stratified sands and gravels. The overburden is in excess of 30 feet thick. The surficial man-made fills are generally 3 to 10 feet thick and consist of loose silty sand (SM) and silty sandy gravel (GP-GM) containing cobbles and minor percentages of wood, roots, organics, cinders and brick fragments. Riprap, varying in layer thickness of from 1 to 3 feet, overlies these fill materials in areas abutting the river. The natural soils, which extend to a depth of at least 30 feet, are somewhat variable and consist of moderately compact to compact, silty sands (SM and SP-SM) gravelly silty sands (SM and SP-SM) and silty sandy gravels (GP and GP-GM). Numerous cobbles are present in the coarser gravelly soils. In general, the gravel contents range from 0 to 65 percent and the silt contents of the soils range from 10 to 30 percent, by weight of the component passing the No. 4 Sieve.

(3) Station 34+30 to 60+35 (Flood Wall). - The overburden materials in this reach consist of variable man-made fills overlying natural deposits of granular soils which in turn are underlain by fine-grained soils. The total overburden thickness is in excess of 30 feet. The man-made fills vary in thickness from 5 to 10 feet and consist of loose silty and gravelly silty sands (SM) and silty sandy gravels (GM), all of which contain cobbles and minor percentages of cinders, ashes, glass, wood and brick fragments. The natural granular soil deposit varies from about 10 to more than 25 feet in thickness and consists of loose to moderately compact, silty and gravelly silty sands (SM and SP-SM), silty sandy gravel (GP-GM) and sandy gravel (GP). These granular soils have gravel contents varying from 0 to 65 percent and silt contents ranging from 10 to 25 percent, by weight of the component passing the No. 4 Sieve. The underlying fine-grained soil deposit is in excess of 15 feet in thickness and consists of highly micaceous, moderately compact to compact, fine sandy silt (ML) containing from 5 to 30 percent sand sizes and a few thin layers of silty fine sand.

(4) Station 60+35 to 82+75 (Dike). - Overburden materials in this reach are in excess of 30 feet thick and consist of natural, gravelly soil deposit underlain by a deposit of fine-grained soils. Between Stations 60+35 and 62+70, the natural soils are overlain by man-made fill up to 15 feet thick, consisting of silt, sand, gravel, cinders, ashes, tar and debris. The natural deposit of gravelly soils is from 5 to 15 feet thick and consists of loose to moderately compact, gravelly silty sand (SP-SM), sand (SP and SP-SM), silty sandy gravel (GP-GM) and sandy gravel (GP). The gravelly materials contain numerous cobbles. The gravelly soils have gravel contents of 40 to 70 percent and silt contents which range from about 5 to 15 percent, by weight of the component

passing the No. 4 Sieve. The underlying fine-grained soil deposits is more than 30 feet thick and consists of highly micaceous, moderately compact to compact, fine sandy silt, (ML) containing from 5 to 30 percent sand sizes and a few thin layers of silty fine sand.

c. Right Bank - Naugatuck River

(1) Station 0+50 to 23+00 (Dike). - Overburden materials in this reach consist of gravelly soils overlain with sandy soils from about Station 6+00 to 23+00 and underlain for the entire reach with fine-grained soils. The gravelly soil deposit is about 8 to 28 feet thick and consists of loose to moderately compact, gravelly silty sand (SP-SM), sand (SP and SP-SM), silty sandy gravel (GP-GM) and sandy gravel (GP). The gravelly soils contain numerous cobbles. The gravelly soils have gravel contents ranging from 25 to 65 percent and silt contents ranging from 5 to 15 percent, by weight of the component passing the No. 4 Sieve. The surficial sandy soil deposit is about 2 to 10 feet thick and consists of loose to moderately compact, silty fine sand and silty medium to fine sand (SM and SP-SM) which have, in general, gravel contents of less than 10 percent and silt contents ranging from 10 to 20 percent. Minor percentages of wood, organics and debris and minor amounts of silty sands containing silt contents between 20 and 25 percent are present in localized areas of this sandy deposit. The fine grained soil deposit is more than 25 feet thick and consists of highly micaceous, moderately compact to compact, fine sandy silt (ML) containing sand contents ranging from 5 to 50 percent and a few thin layers of silty fine sand.

(2) Station 23+00 to 33+70 (Dike). - Overburden materials in this reach are formed, in part, by city dump material underlain by gravelly soils which in turn are underlain by fine-grained soils. Overburden materials are in excess of 30 feet thick. The dump material, composed of trash, is upcto 20 feet thick. The gravelly soil deposit is about 8 to 18 feet thick and the fine-grained soil deposit is more than 30 feet thick. These lower deposits are composed of materials as described in subparagraph (1) above for corresponding deposits.

(3) Station 33+70 to 47+00 (Dike). - The overburden materials along most of this reach consist of man-made fills overlying natural gravelly soils. The overburden is in excess of 30 feet thick, except in the vicinity of Station 37+50 where bedrock was encountered at a depth of 23.7 feet. The man-made fills are up to 6 feet thick and variable but consist essentially of loose to moderately compact, gravelly silty sand (SM). The natural gravelly soil deposit is up to 30 feet thick and consists of loose to moderately compact, silty, medium to fine sand (SM and SP-SM), gravelly silty sand (SM) and silty sandy gravel (GP and GP-GM). The gravelly soils have gravel contents ranging from about 25 to 65 percent

silty sand (SM) and silty sandy gravel (GP and GP-GM). The gravelly soils have gravel contents ranging from about 25 to 65 percent. The silt contents of all natural soils range from about 10 to 20 percent by weight of the component passing the No. 4 Sieve. At the location of one exploration, FT-3, there exists a 12-inch layer of organic silt immediately below the man-made fill. A portion of the existing dike, between right bank station 33+70 and 47+00, as described in paragraph 11, extends into the foundation area of the proposed dike.

(4) Station 47+00 to 54+80 (Dike). - The necessity for the construction of the dike in this reach is dependent on the construction of the adjacent Derby project immediately downstream of the Ansonia-Derby Project. Since the Derby project has been authorized, explorations and final design for the dike in this reach have been deferred pending additional studies for the Derby project. For estimating purposes, it has been assumed that the overburden conditions over much of the reach are similar to those described in Subparagraph (3) above.

d. Ansonia Manufacturing Company

(1) Station 0+30 to 17+50 (Dike and Floodwall). - The overburden materials in this reach are in excess of 30 feet thick and consist essentially of man-made fills overlying natural granular soils. The man-made fills range in thickness from 5 to 13 feet within the foundation area of the dike, and from 12 to 15 feet within the foundation area of the T-wall. These fills consist of cinders, ashes, gravelly silty sand and silty fine sand intermixed with cinders, ashes and brick fragments. The natural granular soil deposit is variable and consists of loose to moderately compact, silty medium to fine sand, gravelly silty medium to fine sand (SM and SP-SM) and silty sandy gravel (GP-GM). The gravel content ranges from 0 to 65 percent and the silt content ranges from about 10 to 30 percent, by weight of the component passing the No. 4 Sieve. The explorations in the reach of the I-wall have been deferred pending determination of the alignments.

e. Beaver Brook.

(1) Station 1+00 to 7+00 (Box Conduit and Open Concrete Channel). - The overburden materials in the foundation areas of the Box Conduit and Open Concrete Channel structures are in excess of 30 feet thick and consist essentially of man-made fills overlying a natural granular soil deposit which, in turn, is underlain by a fine-grained soil deposit. The man-made fills range from 3 to 10 feet in thickness and are composed essentially of silts, sands, gravels, cinders and ashes, and mixtures of all these materials.

The natural granular soil deposit consists of moderately compact to compact, gravelly silty sand (SM and SP-SM), silty sandy gravel (GP-GM) and sandy gravel (GP). These granular soils have gravel contents ranging from 10 to 60 percent and silt contents ranging from 10 to 30 percent, by weight, of the component passing the No. 4 Sieve. The fine-grained soil deposit consists of loose to moderately compact, fine sandy silt (ML) containing sand contents from 5 to 30 percent and a few thin layers of silty fine sand.

(2) Station 7+00 to 24+25 (Dike and Flood Wall). - The overburden materials in this reach consist essentially of man-made fills which overlie a natural granular soil deposit, except where a stratified deposit of sands and organic silt exists between the man-made fills and the granular soil deposit. The granular soil deposit is underlain by glacial till which is underlain by bedrock. The overburden is in excess of 30 feet, except between Stations 16+00 and 20+00 where bedrock was encountered at depths of from 20 to 28 feet. The man-made fill material is about 5 to 13 feet thick and is composed essentially of silty fine sand, gravelly silty sand and silty sandy gravel, all of which are intermixed with minor percentages of ashes, cinders, glass, mortar and brick fragments. The pertinent soils in the natural granular deposit consist of moderately compact to compact, silty and gravelly silty sands (SM and SP-SM), silty sandy gravel (GP-GM) and sandy gravel (GP), all of which contain numerous cobbles and boulders. These granular soils have gravel contents ranging from 10 to 60 percent and silt contents ranging from 10 to 30 percent, by weight of the component passing the No. 4 Sieve. The stratified deposit between approximate Stations 17+00 and 24+25 varies in thickness from 1 to 8 feet, with the greatest thickness near Station 24+25, and consists of alternate layers of sandy organic silts and silty sands. The thickness of the sandy organic silt layers varies from about 0.5 to 2.0 feet. The glacial till deposit, about 6 to 10 feet thick, is composed of compact, gravelly silty sand (SM) with silt contents ranging from 15 to 40 percent, based on the component passing the No. 4 Sieve.

(3) Station 24+25 to 31+25 (Box Conduit). - The overburden materials in the foundation area of the Box Conduit structure in this reach consists essentially of man-made fills, about 5 to 10 feet thick, which overlie natural soils. The natural soils between Stations 24+25 and 26+00 consist of a deposit varying in thickness from 2 to 10 feet of medium stiff organic silt, with a bottom elevation at about 0.0 m.s.l., which overlies a deposit of fine grained soils. Between Stations 26+00 and 31+25, the natural soils consist of granular soils which overlie a deposit of fine-grained soils. The man-made fills are composed essentially of gravelly silty sand and silty fine sand intermixed with a minor percentage of cinders, ashes, coal, brick fragments and organics. The deposit of granular soils

is composed of loose to moderately compact sandy gravel (GP) and gravelly silty sand (SM and SW-SM). The deposit of fine-grained soil is composed of moderately compact to compact, highly micaceous silty fine sand (SM) and fine sandy silt (ML) which have sand contents ranging from 20 to 60 percent.

7. Shear Strengths. - No shear tests were performed on samples of man-made fill or natural foundation soils. On the basis of visual examination of the samples, their grain size distribution curves, the exploration logs and experience with similar materials, it is considered that the following shear strength parameters for all conditions will provide a reasonable basis for embankment stability studies. The shear strength of the sandy organic silt and trash fill deposits, existing in certain reaches of the dike and wall alignments, have not been estimated since they will be removed from foundation areas of concrete structures and from the foundation areas of the dikes where their occurrence would be detrimental to the stability of the selected dike sections.

Foundation Soil	ϕ Degrees	c TSF c
Silty sands, gravelly silty sands, silty sandy gravels and sandy gravel.	30°	0
Silty fine sands and fine sandy silts	25°	0
Man-made granular fill materials	25°	0

8. Permeability. - The permeability characteristics of the foundation soils vary widely. No permeability tests were made on foundation soils since the relative permeability characteristics can be judged with sufficient accuracy by visual inspection of the samples, their grain size distribution curves and experience with similar materials. It is estimated that the vertical coefficients of permeability will be within the following ranges:

Foundation Soil	K_v/cm/sec)	$\frac{Kh}{K_v}$
Gravelly silty sands, silty sandy gravels and sandy gravels	100 to 400 x10-^{4}	4 to 9
Silty sands	10 to 50x10-^{4}	4 to 9
Silty fine sands and fine sandy silts	0.1 to 1.0x10-^{4}	9 to 16
Man-made granular fill	10 to 300x10-^{4}	4 to 9

9. Consolidation. - Consolidation tests were not performed on samples of foundation soils for this project. Except for the sandy organic silt material present in certain reaches of the dike and box conduit alignment along Beaver Brook and the loose trash fill composing the city dump, the foundation materials exhibit very low compressibility characteristics. The organic silt materials, while relatively compressible, occur generally in thin strata and their consolidation will be of acceptable magnitude in dike areas. The organic silt material in the foundation area of the box conduit will be removed. All trash fill in the foundation areas of dikes and walls will be removed prior to construction.

D. DISTRIBUTION, TYPES AND USES OF EARTH MATERIALS FROM REQUIRED EXCAVATIONS

10. General. - Excavation of large quantities of natural earth and man-made fill materials is required for the construction of channels, dikes, walls and concrete structures. Suitable natural earth and existing fill materials obtained from required excavations will be used in the construction of the pervious, gravel and random fill sections of dikes and along walls. Unsuitable natural earth and man-made fill materials containing objectionable amounts of ashes, cinders, trash, organics and debris will be disposed of in part in on-site designated areas but in general will be disposed of in areas off-site selected by the contractor.

11. Naugatuck River Channel Improvement. - The improvement of the Naugatuck River Channel downstream of the Railroad Bridge will require the excavation of approximately 354,000 cubic yards of materials. Overburden within this reach of the channel and above the depths of required excavation consist, in general, of surficial deposits 2 to 10 feet thick, of silty sand and trash which are underlain by a gravelly deposit. Trash deposits up to 20 feet thick exist in an area along the left side of the channel between left bank stations 55+00 and 60+00 and along the right side of the channel between right bank stations 23+00 and 33+70. The surficial deposit of silty sand is composed of silty fine sand, silty medium to fine sand and gravelly silty sand and exists over the entire channel area and beyond the limits of the present channel area except where trash fill exists. The gravelly deposit, which exists beneath the surficial deposits of silty sands and trash and as a surficial deposit in the existing river channel, consists of sandy gravel, silty sandy gravel, gravelly sand and sands. The surficial silty sands generally have gravel contents of less than 10 percent and silt contents ranging from 5 to 20 percent. A limited quantity of the silty sands have a silt content up to 25 percent. The materials in the gravelly deposit generally have gravel contents ranging from 40 to 70 percent and silt contents of less than 8 percent. There exists on the right bank of the present river channel between right bank stations 33+70 and 47+00, a dike about 15 feet high which will be removed for channel improvement. The soils in the dike consist in general of sandy gravel and silty sandy gravel and probably gravelly sand and sand. These dike materials, in general, have gravel contents ranging from 30 to 70 percent and silt contents of less than 8 percent.

Overburden materials, to be excavated within the reach of the channel upstream of Maple Street Bridge, consist of 12 to 15 feet of man-made fill which overlies natural granular soils. The fills consist of cinders, ashes, gravelly silty sand and silty fine sand

intermixed with cinders and ashes. The natural granular soils are similar to those of the gravelly deposit downstream of the Railroad Bridge. Suitable materials from all channel improvement will be used as pervious, gravel and random fill materials.

12. Beaver Brook Channel Improvement. - The materials to be excavated consist mainly of materials in a man-made fill deposit, 5 to 13 feet thick, of silty fine sand, gravelly silty sand and silty sandy gravel intermixed with minor percentages of ashes, cinders, glass, mortar and brick fragments. These fills generally have gravel contents of less than 50 percent and silt contents ranging from 10 to 30 percent. Suitable materials from these excavations will be used as random fill material.

13. Toe Drains and Foundation Cut-offs. - Materials from excavations for toe drains and foundation cut-offs will consist essentially of man-made fill and natural granular and fine-grained soils. Materials from toe drain excavations for the Right Bank Dike will consist essentially of silty fine sands, silty medium to fine sands and silty sandy gravels which generally have gravel contents of less than 10 percent and silt contents between 5 and 20 percent. Materials to be excavated for the toe drain and the partial foundation cut-off of the Left Bank Dike between stations 0+10 and 7+80 will consist of gravelly silty sand, silty sandy gravel and sandy gravel containing cobbles and a minor percentage of cinders, ashes and brick fragments. These materials generally have gravel contents ranging from 30 to 65 percent and silt contents of the minus No. 4 component, of less than 20 percent. Materials excavated for the Beaver Brook Dike toe drain will consist of silty sandy gravels, gravelly silty sands and silty fine sands containing minor percentages of cinders, ashes, glass, mortar and debris and some sandy organic silt. Excavation for the Ansonia Manufacturing Company Dike toe drain and foundation cut-off will consist essentially of cinders and ashes, intermixed with some silt, sands and gravels. Excavation for the foundation cut-off for the Left Bank Dike between stations 60+70 and 79+50 will consist essentially of materials from the gravelly deposit described in Paragraph 11. Suitable materials from this excavation, for the Left Bank Dike between stations 0+10 and 7+80 and for the Beaver Brook Dike will be used as random fill material. In general, materials from the excavations for the toe drains and the foundation cut-off for the dikes downstream from the Railroad Bridge will be used as pervious and gravel fill materials. It is anticipated that all material from the excavations for the Ansonia Manufacturing Company Dike will be unsuitable for earth fill material.

14. Concrete Structure Excavations. - The construction of walls and structures along the right and left bank of the Naugatuck River, except between stations 7+80 and 21+00 on the left bank, and of the walls, box conduits and open channel structures along the Beaver Brook alignment will involve the excavation of existing man-made fills consisting essentially of cinders and ashes, and silts, sands and gravels intermixed with cinders, ashes, mortar, glass, organics and debris. It is anticipated that none of these materials will be suitable as earth fill materials except perhaps a small percentage will be suitable as random fill material. The construction of the Left Bank Wall Structure between approximate stations 7+80 and 21+00 will involve the excavation of gravelly silty sand, silty sandy gravel and sandy gravel with a very minor percentage of cinders, ashes and brick fragments. These materials generally have gravel contents ranging from 30 to 65 percent and silt contents of the minus No. 4 component of less than 20 percent. Suitable materials within this reach will be salvaged and utilized as pervious fill material.

E. CHARACTERISTICS OF EMBANKMENT MATERIALS

15. Embankment Materials from Required Excavations. -

a. Description of Materials. -

(1) Pervious Fill Material. - Pervious fill material will be obtained from the required excavations for the Naugatuck River Channel Improvements, for the Right Bank Dike foundation toe drain, for the Left Bank Dike foundation cut-off and for the reach of wall between left bank stations 7+80 and 21+00. Pervious fill materials will consist of silty fine sands, silty medium to fine sands, silty sandy gravels and sandy gravels having gravel contents ranging from 0 to 70 percent and silt contents of less than 20 percent, based on the component passing the No. 4 Sieve. In general, the pervious fill material will have silt contents between 5 and 15 percent, based on the component passing the No. 4 Sieve. A very limited amount, as approved by the Contracting Officer, of material containing between 20 and 25 percent silt, based on the minus No. 4 component, will be used as pervious fill material. Some of the pervious fill material may contain a minor amount of ashes, cinders, concrete, bricks and similar material as approved by the Contracting Officer.

(2) Random Fill Material. - Random fill material will be obtained mainly from excavations for channel improvements, the Left Bank Dike between stations 0+10 and 7+80 and the Beaver Brook Dike. A small portion of the required random fill material might be obtained from excavations for concrete structures. If additional random fill material is required, impervious fill material from the designated borrow area will be used as random fill

material. Random fill material will consist essentially of silty fine sands, gravelly silty sands and silty sandy gravels free of debris, stumps, wood, topsoil and organics except that portions of it may contain ashes, cinders, bricks, concrete and similar materials in amounts considered not detrimental by the Contracting Officer. The silt contents of these soils will generally be in excess of 20 percent, based on the component passing the No. 4 Sieve.

(3) Gravel Fill Material. - Gravel fill material will be selected material obtained from the required excavations for the Naugatuck River Channel Improvement downstream from the Railroad Bridge. The gravel fill material will consist of sandy gravels and gravelly sands with gravel contents of at least 40 percent and silt contents of less than 10 percent, based on the component passing the No. 4 Sieve.

b. Permeability. - Permeability tests were not performed on samples of pervious, random or gravel fill materials. On the basis of visual examination of the samples, their grain size distribution curves, the specified gradations and experience with similar materials, the following coefficients of permeability have been estimated.

Fill	Kv/cm/sec	K_h/kv
Pervious Fill	20 to 300×10^{-4}	4 to 9
Random Fill	1 to 100×10^{-4}	4 to 9
Gravel Fill	100 to 400×10^{-4}	1

c. Shear Strengths. - Shear tests were not performed on samples of pervious, random or gravel fill materials. Based on visual examination of the samples and experience with similar materials, it is estimated that the shear strength parameters will be in excess of the following values.

Fill	ϕ - degrees	c-Tsf
Pervious Fill	30	0
Random Fill	30	0
Gravel Fill	35	0

d. Compaction. - Compaction tests were not performed on samples representative of material to be utilized as compacted

pervious, random or gravel fill materials. On the basis of past experience with similar materials, it is anticipated that the natural moisture content of these materials will be within ranges permitting adequate compaction without additional moisture content control. Estimated in-place dry densities of the compacted pervious and random fill materials will be on the order of 125 p.c.f. and on the order of 130 p.c.f. for compacted gravel fill material.

16. Embankment Material from Borrow Area. -

a. Impervious Fill Material. - Impervious fill material will be obtained from a Government-furnished borrow area. Explorations are in progress in one area which will probably be selected for the impervious fill borrow area. The location of this probable source is shown on Plates 6-1 and 6-26 and the gradation range of the material available is shown on Plate 6-27. The material is a glacial till and consists of a well-graded, nonplastic gravelly silty sand (SM) with at least 30 percent passing the No. 200 Sieve based on the component passing the No. 4 Sieve. Any other source considered for a borrow area will contain similar impervious fill material.

b. Permeability. - Permeability tests were not performed on samples of impervious fill materials. On the basis of visual examination of samples, their grain size distribution curves and past experience with similar materials, it is estimated that compacted impervious fill will have a coefficient of permeability of less than 1×10^{-4} cm/sec,

c. Shear Strength. - Shear tests were not performed on samples of impervious fill materials. Based on experience with similar materials, it is estimated that the compacted impervious fill will have shear strength parameters in excess of $\phi = 30$ degrees and $c = 400$ p.s.f. which are applicable for embankment design.

d. Compaction. - After the borrow area is selected, laboratory compaction tests will be made on representative samples to determine the standard maximum density and optimum moisture for compaction. Based on past experience with similar materials and available moisture content data, it is anticipated that the placement moisture content of the materials in the area now being explored can be controlled with minus 2 to plus 2 percent of the optimum water content with minor moisture control. The in-place dry density of the compacted impervious fill will be on the order of 120 p.c.f.

17. Materials Furnished by the Contractor. -

a. General. - Crushed stone fill, filter sand and gravel bedding materials will be furnished by the contractor. Investigations indicate that the probable commercial sources for filter sand and natural sources for gravel bedding material are within a haul distance of less than 10 miles. Crushed stone is available from a commercial source located about 20 miles truck haul distance from the site. The specifications for materials which will act as a filter have been established in accordance with the filter design criteria set forth in Engineering Manual for Civil Works Construction. The materials will have the following gradation specifications:

(1) Crushed Stone Fill. - Crushed stone fill material for use in the construction of the Left and Right Bank Dike foundation toe drains shall consist of material meeting the gradation specifications for 1/4 to 3/4-inch concrete aggregate.

(2) Filter Sand. - Filter sand material for use in the construction of the Left and Right Bank Dike foundation toe drains shall consist of material meeting the gradation specifications for fine concrete aggregate.

(3) Gravel Bedding. - Gravel bedding material shall consist of reasonably well-graded bank-run sandy gravel or gravelly sand. Of the material passing the 3-inch screen between 40 and 70 percent by weight shall be retained on the No. 4 Sieve. Of the material passing the No. 4 Sieve, not more than 15 percent, by weight, shall pass the No. 200 Sieve.

b. Permeability. - Permeability tests were not performed on samples of crushed stone fill, filter sand or gravel bedding materials. On the basis of visual examination of samples, their grain size distribution curves, the specified gradations and experience with similar materials, the following coefficients of permeability have been estimated.

Material	Kv-cm/sec	K_h/Kv
Crushed Stone Fill	1000 to 2000×10^{-4}	1
Filter Sand	100 to 400×10^{-4}	1
Gravel Bedding	50 to 300×10^{-4}	1

c. Shear Strengths. - Shear tests were not performed on samples of crushed stone fill, filter sand or gravel bedding

materials. Experience with similar materials indicate that the following estimated shear strength parameters are conservative for the materials after placement.

Material	Ø-degrees	c-Tsf
Crushed Stone Fill	35	0
Filter Sand	30	0
Gravel Bedding	35	0

F. DESIGN OF EMBANKMENTS

18. Design Criteria. - The designs of the embankments for this project were developed in accordance with the criteria set forth in the pertinent sections of the Engineering Regulations for Civil Works Construction ER 1110-2-2300 "Earth Embankments" and Regulations and Bulletins referred to therein.

19. Materials for Embankment Construction. a. Materials from Required Excavations. - Present estimates indicate that there will be about 645,700 cubic yards of excavation required for the construction of this project. Of this quantity about 184,700 cubic yards will consist of stripping and man-made fill material unsuitable for use in the construction of the embankments and fills along walls and concrete structures. Of the remaining 461,000 cubic yards, 387,400 cubic yards will be used as pervious and gravel fill materials and 74,600 cubic yards will be used for random fill material. The foregoing quantities represent excavation volumes to which a balance factor must be applied to obtain the corresponding embankment quantities. To account for losses due to shrinkage, waste and other causes, a balance factor of 0.8 has been selected.

b. Borrow. - Impervious fill material will be obtained from an off-site borrow area. Present estimates indicate that approximately 160,000 cubic yards (embankment volume) of material is required. Since a definite borrow source has not been established, total excavation quantities are not known. It is anticipated, however, that the total excavation quantities will be on the order of 250,000 cubic yards, of which approximately 90,000 cubic yards will be stripping and losses due to oversize stones, waste and shrinkage during compaction.

c. Materials Furnished by the Contractor. - Filter sands, crushed stone, gravel bedding and rock materials as required for the construction of the embankments will be furnished by the contractor.

d. Materials Usage. - A chart showing the proposed usage of materials from required and borrow excavations and materials furnished by the contractor is shown on Plate 6-36. The quantities shown are preliminary and will be subject to modification during the preparation of contract plans and specifications. The chart includes the random fill and sand fill required for the construction of concrete structures.

20. Selection of Embankment Sections. The embankment sections for the various reaches of the dikes, developed as a result of design studies, are shown on Plates 6-28 and 6-29. The selection of the

embankment sections was influenced by the foundation conditions, the availability and characteristics of earth and gravel materials from required excavations and other sources, seepage control requirements, stream erosion and construction considerations. In general, the dike embankments consist of a zone of either compacted pervious or compacted random fill with an inclined riverside zone of compacted impervious fill and a landside toe drain of either crushed stone or gravel fill materials with rock protection on the exposed slope. The earth embankment materials will be protected by layers of gravel and rock on the riverside to withstand stream velocities and by seeded topsoil on the landside to provide a turf that will withstand erosion due to rainfall and also to provide esthetic qualities.

21. Seepage Control. a. Embankment Through Seepage. - The control of seepage through the embankments will be provided by the arrangement, size and difference in permeability of impervious fill, pervious fill and random fill zones and the gravel fill and crushed stone fill toe drains. It is estimated that the difference in permeability of the various fills is amply adequate for the control of seepage through the dike embankment.

b. Foundation Seepage, General. - The seepage through the foundation soils of the embankments will be controlled by the incorporation of toe drains and foundation earth cutoffs where such features are required. The designs are based on the assumption that maximum seepage pressures in the foundation soils will be developed with the water on the riverside of the dikes at an elevation 3 feet below the tops of the dikes. The features provided for the various reaches of the dike foundations are shown on typical sections, Plates 6-28 and 6-29. These features are considered adequate to prevent the formation of seepage pressures that will detrimentally affect the stability of the structures. Where crushed stone fill is designated in the landside toe drains, layers of filter sand have been provided, where necessary, to insure that migration of foundation and embankment materials into the crushed stone will not occur. Drain pipes are provided in the toe drains to carry foundation seepage water to pumping stations and to prevent, if the pipe is functioning, water from exiting at the surface. Special provisions will be made in the specifications to insure that seepage will not occur along or through existing or new utilities. These provisions will include removal of existing utilities, concrete encasements of existing and new utilities and installation of concrete seep rings.

c. Foundation Seepage, Downstream from Railroad Bridge. - The toe drains for the Left and Right Bank Dikes between the Railroad Bridge and Division Street Bridge will extend to the nearly horizontal foundation gravelly stratum which has, in general, an estimated coefficient of permeability of between 200×10^{-4} and 400×10^{-4} cm/sec.

The toe drain for the Right Bank Dike downstream of Division Street Bridge will extend through the surficial man-made granular fill into the underlying deposit of natural pervious soil. Crushed stone, 3/4" to 1/4", has been selected for the toe drain material to insure a more pervious material than the material in the foundation zones being tapped. In addition to the toe drain, the foundation seepage for the Left Bank Dike downstream from the Railroad Bridge will be controlled by a foundation earth fill cut-off extending through the very pervious surficial gravel deposit to the underlying fine-grained soil deposit. The incorporation of both a foundation cut-off and a toe drain for this reach of dike is considered advisable since the landside area is being devloped for urban renewal, both commercial and industrial, and the overburden in this area for a depth of about 12 feet is man-made fill composed mainly of ashes, cinders and debris. It was concluded from studies that construction of a foundation earth fill cut-off is not justified for the Right Bank Dike between the Railroad Bridge and the Division Street Bridge due to the depth to the surface of the foundation stratum of fine-grained soils.

d. Earthfill Contact with Concrete Structures. - At junctures of concrete walls and the dike embankments, special dike wraparounds will be constructed to provide an adequate creep ratio. In addition, all impervious fill material in the wraparounds adjacent to concrete structures will be carefully compacted by special means to produce a tight contact with the wall and to obtain a high degree of density in the zone where rolling compaction equipment cannot or should not operate.

22. Embankment Stability. - a. General. - The embankment sections selected for the dikes at the most critical locations have been analyzed for stability against shear failure using the method of infinitesimal slices. These analyses indicate that the embankments will be stable under all river stage conditions anticipated. Embankment riverside sections at Stations 71+55 and 19+60 on the left and right bank, respectively, were analyzed using assumptions consistent with conditions immediately after construction and during drawdown from the maximum river stage. Because of the short duration during which maximum stages will occur, and the permeability and size of the pervious zone, it has been assumed for the rapid drawdown analyses that the pervious zone of the embankments will drain rapidly enough to prevent the occurrence of excess pore pressures within the pervious zone.

b. Selection of Design Values. - The design unit weights for embankment and foundation materials have been selected using estimated densities based on experience with similar materials. Design shear strength parameters have been selected on a similar basis. The various design values (Q and R only) used in the analyses are tabulated below:

Material	Unit Weight - Pcf Sat	Moist	Dry	Sub	Shear Strength
Stone Protection	140	-	120	78	$\phi = 35^\circ$ C = 0
Gravel Bedding	145	140	130	83	$\phi = 30^\circ$ C = 0
Compacted Impervious Fill	140	130	120	78	$\phi = 30^\circ$ C = 400 PSF
Compacted Pervious Fill and Gravel Fill	145	140	130	83	$\phi = 30^\circ$ C = 0
Foundation Sands and Gravel	145	140	130	83	$\phi = 30^\circ$ C = 0
Foundation Sandy Silts and Very Silty Fine Sands	120	100	90	58	$\phi = 25^\circ$ C = 0

c. Results of Stability Analyses. - The results of the stability analyses are summarized on Plates 6-30 and 6-31. Typical analyses are shown on Plates 6-32 through 6-35. The minimum factors of safety against shear failure as determined by the analyses are tabulated below. These minimum factors of safety are considered adequate and indicate that the selected sections are safe against shear failure.

Condition Analyzed	Minimum Factor of Safety Left Bank	Right Bank
Rapid Drawdown	1.14	1.03
Construction	1.60	1.42

23. Embankment Settlements. - Except for the thin strata of sandy organic silt material in the foundation of the Beaver Brook Dike and the loose trash fill composing the city dump, the foundations and fills for this project are of types which normally show very low compressibility. Considering the thickness of the organic silt layers their consolidation will not be significant, and will occur during construction. The existing trash fills will be removed from the foundation areas prior to construction of dike embankments. No significant settlements are therefore expected to occur either in the foundations or within the embankments.

24. Construction Considerations. - a. Dewatering Construction Areas. - Dewatering will generally be specified for all areas in which

compacted embankment fills are to be placed. An exception to this will be permitted in the reach of the Left Bank Dike between Stations 60+70 and 81+00 where a gravel fill zone has been provided to serve as a permanent cofferdam. Specifications will allow the initial placement of this material in the wet and compaction of the gravel fill will only be required above the river water level. It is anticipated that the depth of water will generally be less than 2 feet and that the placement of gravel fill below water will be accomplished by end dumping and pushing, thereby minimizing any segregation.

b. Rate of Embankment Construction. - Contract specifications will require that each fill zone of a dike be constructed to its full width and for a reach sufficiently long to permit proper operation of compaction equipment. The specifications will not require the simultaneous construction of adjacent fill zones except where required by limitations. Specifications will require that partially completed embankments will be completed to their full width, including stone protection, during certain flood seasons.

G. SLOPE AND CHANNEL PROTECTION

25. New Stone Protection. - The river side slopes of dikes, the side slopes of channel improvements, the bottom of channel improvements for Beaver Brook and the bottom of the Naugatuck River Channel Improvement between left bank stations approximately 19+50 and 34+00 will be protected from erosion by quarry stone overlying a layer of gravel bedding. The protection materials will be furnished by the contractor. The gravel bedding material will meet the requirements stated in Paragraph 17. The design flood average velocities along the various reaches of the project are as follows:

Area	Average velocities - FPS
Lower End of Protective Works to Downstream NY NH&H RR Bridge (except at Division St. Bridge)	8 to 10
Division St. Bridge	12
NY NH&H RR Bridge	17
NY NH&H RR Bridge to Maple St. Bridge	10 to 13
Maple St. Bridge to American Brass Co. Bridge	15 to 17
American Brass Co. Bridge	17
Upstream from American Brass Company Bridge	9
Beaver Brook Station 7+00 to 24+25	12 to 16

In selecting the thicknesses of stone protection in the various reaches, the data in EM 1110-2-3901 and the above average velocities were used as a guide. The thicknesses in the Manual were considered applicable in reaches where the above average velocities are near the bottom of the ranges of velocity given in the Manual except at bends and where channel restrictions will affect the flow. Where channel restrictions will affect the flow and in reaches of bends, greater thicknesses than those shown by the Manual have been selected and their magnitude in part are based upon the anticipated river flow conditions. The stone sizes for any layer thickness will be the same as stated in the Manual for the particular corresponding layer thickness. The layer thicknesses and their extent are shown on Plates 6-3 through 6-15 and Plates 6-28 and 6-29.

26. Channel Bottom Downstream of Railroad Bridge. - No stone protection will be provided on the channel bottom of the Naugatuck River below the Railroad Bridge except in the vicinity of the Division Street Bridge and in the discharge area of the conduit of the Beaver Brook alignment. The layer thickness and stone sizes of the protection in the discharge area will be selected after completion of additional studies. It is considered that the gravelly and cobbly nature of the materials that will exist in the channel bottom, except in areas noted above, will be adequate for channel bottom protection, except where these gravel materials are less than 2 feet thick. Where the natural gravelly material is not 2 feet thick, a layer 2 feet thick of gravel fill will be provided. Based on exploration information, it is anticipated that such a layer will be necessary in the eastern portion of the channel bottom between left bank stations approximately 70+50 and 74+50.

27. Existing Slope Protection. - The existing slope of the left bank of the Naugatuck River upstream of the American Brass Company Bridge is protected with stone. This stone protection, except in the discharge channel of the hydroplant of the American Brass Company, is about 2 feet thick and is composed of well-graded quarry rock with a maximum size of about 400 pounds. In the discharge channel, the protection consists of hand placed riprap with stones weighing about 500 pounds. All stone protection rests on fill composed of sandy gravel. Except for a few minor areas, this stone protection appears more than adequate for the velocity condition of the river at flood stage. A portion of the stone protection will be removed for the construction of the Left Bank Wall between stations 7+80 and 19+50. In this area, new stone protection will be provided in accordance with the criteria for other river reaches as described in paragraph 25.

H. PERMANENT CUT SLOPES

28. General. - Permanent cut slopes of the Naugatuck River and Beaver Brook Channels will be excavated either to slopes of 1 vertical to 2 horizontal or 1 vertical to 2.5 horizontal. These slopes are considered adequate with respect to stability. Permanent cut slopes which may be subjected to erosion by flood waters will be protected with stone protection overlying a gravel bedding layer. Permanent cut slopes not subjected to flooding will be topsoiled and seeded.

I. CONCRETE STRUCTURES - EARTH FOUNDATIONS AND SEEPAGE CONTROL

29. Pumping Stations. -

a. River Street Pumping Station. - The River Street Pumping Station will be constructed landside of the Ansonia Manufacturing Company Dike at approximately Station 6+00. The structure is approximately 14 feet wide and 17 feet long with a foundation elevation of about plus 17 m.s.l., exclusive of exterior intake and discharge chambers. The foundation materials at and below the elevations for all footings consist of natural, moderately compact to compact, silty sandy gravel (GP-GM) and silty sand (SM). The foundation soils are considered adequate for the foundation of the structure. No provisions for seepage control are required.

b. Maple Street Pumping Station. - The Maple Street Pumping Station will be constructed as an integral part of the floodwall between approximate left bank stations 34+55 and 34+75. The structure is approximately 19 feet wide and 20 feet long with a foundation elevation of about plus 12.0 m.s.l., exclusive of exterior intake and discharge chambers. The overburden materials at the location of the structure are indicated by the data of boring FD-58 shown on Plate 6-22. The foundation materials at and below the elevations for all footings consist of natural, moderately compact to compact, silty sandy gravel (GP-GM) and gravelly silty sand (SP-SM), which are considered competent to support the proposed structure. No provisions are considered necessary for foundation seepage control.

c. Division Street Pumping Station. - The Division Street Pumping Station will be constructed landside of the Right Bank Dike at approximately station 34+70. The structure is approximately 19 feet wide and 34 feet long with a foundation elevation of about minus 1.5 m.s.l., exclusive of exterior intake and discharge chambers. The overburden materials in the vicinity of the structure are indicated by the data of boring FD-71 shown on Plate 6-20. The foundation materials at and below the elevations for all footings consist of

natural, moderately compact, silty sandy gravel (GP-GM), gravelly silty sand (SP-SM) and silty sand (SM). The foundation soils are considered adequate for the proposed structure. No provisions are necessary for foundation seepage control except for the careful placement of fill around the conduit where it is in the dike foundation area.

d. Front Street Pumping Station. - The Front Street Pumping Station will be constructed landside of the Left Bank Dike at approximately station 75+00. The structure is approximately 19 feet wide and 34 feet long with a foundation elevation of about plus 2.5 m.s.l., exclusive of exterior intake and discharge chambers. The overburden materials at the location of the structure are indicated by the data of borings FD-2 and FD-3 shown on Plates 6-23 and 6-25, respectively. The foundation materials at and below the elevations of the footings consist of about 2 feet of moderately compact silty sandy gravels (GP-GM) which are underlain by compact fine sandy silts (ML). These foundation soils are considered adequate for the foundation of the structure with no significant settlement expected as a result of the consolidation of the lower fine sandy silt material. The bearing pressures are low and no vibration from the pumps is anticipated. No provisions are necessary for foundation seepage control except for careful placement of fill around the conduit where it is in the dike foundation.

30. Street and Railroad Gates. -

a. Street Gate No. 1. - Street Gate No. 1 will be constructed at approximately left bank station 20+00. The overburden materials in the area of the structure are indicated by the data of boring FD-47 shown on Plate 6-22. The overburden materials consist of man-made granular fills that overlie natural granular soils. The man-made fill is about 17 feet thick and consists of loose to moderately compact, silty sandy gravel (GP-GM) with cobbles and very minor percentages of cinders, ashes and brick. The natural material underlying the fill consists of moderately compact to compact, gravelly silty sand (SM) and silty sandy gravel (GM). The structure will be founded on or slightly above the natural soil at about elevation 20.0 m.s.l. The foundation materials are considered satisfactory to support the proposed structure. Seepage through the foundation of the gate structure will be controlled by a landside drainage zone. A perforated pipe drain will be installed in the drainage zone to carry seepage water to the pumping station.

b. Street Gates Nos. 2 and 3. - Street Gates Nos. 2 and 3 will be constructed at the locations shown on Plate No. 6-5.

The overburden materials in the areas of the structures are indicated by the data of borings FD-65 and FD-46 for Gate No. 2 and Gate No. 3, respectively. Engineering logs of these borings are shown on Plate 6-24. The overburden materials at each of the gate structures are similar and consist of man-made fills overlying natural granular soil. The man-made fill consists of cinders, ashes, gravelly silty sand and silty sand intermixed with cinders and ashes. The fills are about 12 feet thick at Gate No. 2 and about 14 feet thick at Gate No. 3. The natural granular soil is somewhat variable and consists of loose to moderately compact, silty medium to fine sand (SM), gravelly silty medium to fine sand (SM and SP-SM) and silty sandy gravel(GP-GM). The structures will be founded at about elevation 17.0 m.s.l. on the natural soils, which are considered satisfactory to adequately support the structures. No provisions are considered necessary for control of seepage through the foundation since the hydraulic heads involved are low and the bases of the structures will be approximately 15 feet below the ground surfaces.

c. Railroad Gate No. 1. - Railroad Gate No. 1 will be constructed at approximately left bank Station 1+00. The overburden materials in the area of the structure are indicated by the data of boring FD-86 shown on Plate 6-22. The overburden materials consist of a granular deposit of loose to moderately compact, gravelly silty sand (SP-SM) and silty sandy gravel (GP-GM) which overlies bedrock at a depth of 18 feet. The gate structure will be founded on the granular soils which are considered competent to support the proposed structure. Seepage through the foundation of the gate structure will be controlled by a landside drainage zone. A perforated pipe drain will be installed in the drainage zone to carry seepage water to the pumping station.

d. Railroad Gate No. 2. - Railroad Gate No. 2 will be constructed at approximately left bank station 42+00. The overburden materials at the location of the structure are indicated by the data of boring FD-64 shown on Plate 6-23. The overburden materials consist of man-made fill which overlies natural granular soils. The man-made fill is about 10 feet thick and consists of loose to moderately compact silty sandy gravel with cobbles and brick fragments. The natural granular soils consist of moderately compact to compact, gravelly silty sand (SM), silty sandy gravel (GP-GM) and silty medium to fine sand (SM). The structure will be founded at or below elevation plus 15.0 m.s.l. on the natural granular soils. These foundation soils are considered adequate for the foundation of the structure. Seepage through the foundation of the structure will be controlled by a landside drainage zone containing a perforated pipe. The perforated pipe will serve to carry seepage water to the pumping station.

e. Railroad Gate No. 3. - Railroad Gate No. 3 will be constructed at approximately left bank station 60+50. Overburden materials in the area of the structure are indicated by the data of boring FD-90 shown on Plate 6-23. The overburden materials consist of a man-made fill which is underlain by a deep deposit of fine-grained natural soils. The man-made fill is about 15 feet thick and consists of loose silty sand with cinders, ashes, and brick fragments. The underlying fine-grained soil deposit is more than 15 feet thick and consists of moderately compact to compact fine sandy silt (ML). The man-made fill material is considered not satisfactory as a foundation material. The material of the fine-grained soil deposit is considered satisfactory as a foundation material. These conditions will be considered in the design and preparations of the foundation during the design studies of the structure. Necessity for seepage control will depend upon final design of the structure.

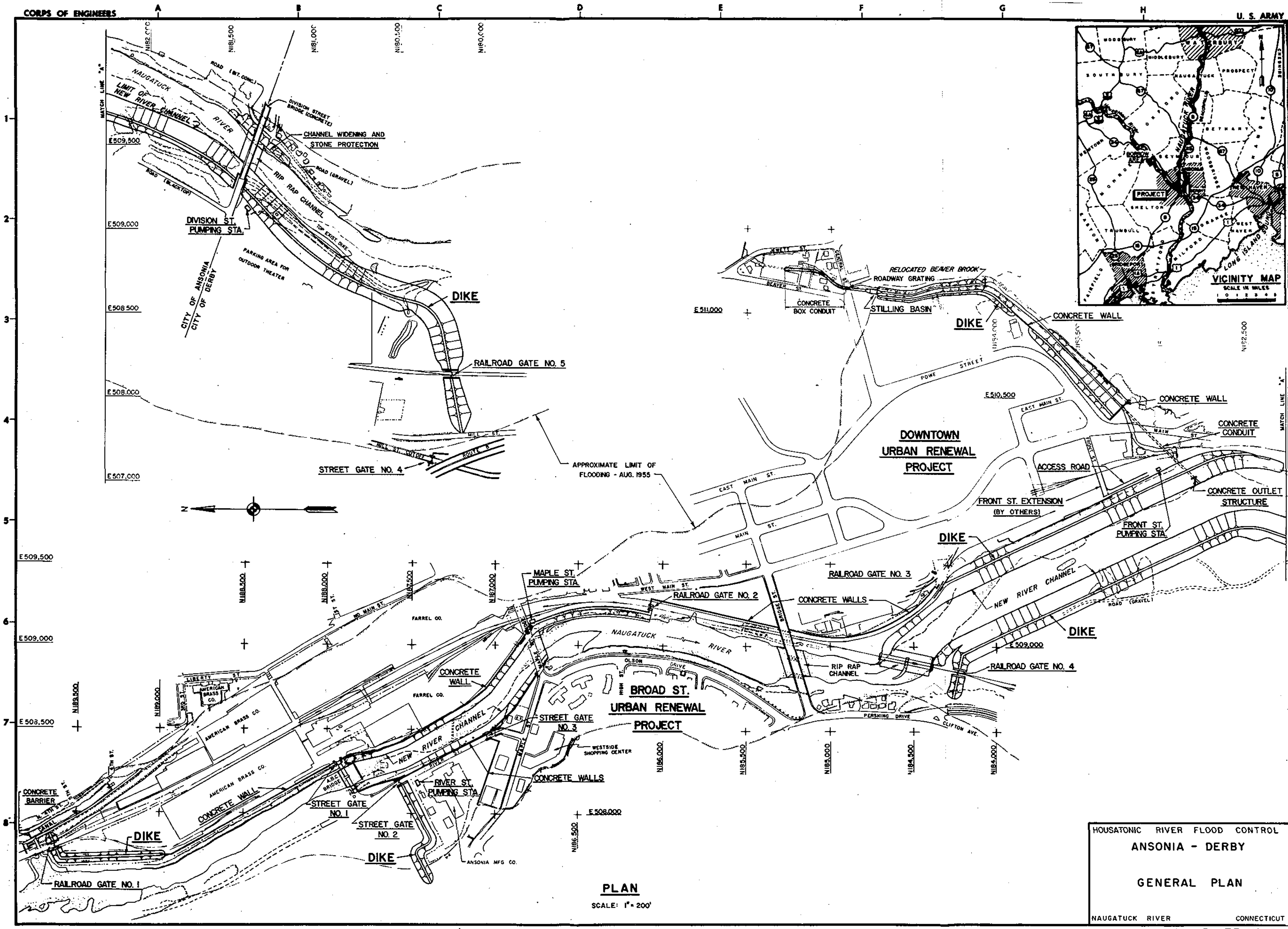
f. Railroad Gate No. 4. - Railroad Gate No. 4 will be constructed at approximately right bank station 2+00. Overburden materials at the location of the structure are indicated by the data of boring FD-88 shown on Plate 6-20. The overburden materials consist of a 25 foot granular deposit of moderately compact, gravelly sand (SP) and silty sandy gravel (GP-GM) which overlies fine sandy silt (ML) soil. The structure will be founded on the granular foundation materials at about elevation plus 18.0 msl. These soils are considered satisfactory to adequately support the structure. Seepage through the gate structure foundation will be controlled by a landside drainage zone containing a perforated pipe. The pipe will carry seepage to a pumping station.

g. Railroad Gate No. 5 and Street Gate No. 4. - Railroad Gate No. 5 and Street Gate No. 4 will be located as shown on Plate No. 6-13, if they are constructed. The necessity for these gates is dependent on the construction of the adjacent Derby project. Since the Derby project has been authorized, explorations and final design for these structures have been deferred pending additional studies for the Derby project.

31. Beaver Brook Box Conduits and Open Concrete Channel. - Distribution and description of the overburden materials in the foundation areas of the Box Conduits and the Open Concrete Channel are described in Subparagraph 6e. The box conduit and open channel structures to be constructed between station 1+00 and 7+00 will be founded on the natural compact granular materials. The base elevation of the Box Conduit between stations 24+25 and 31+25 will be below the top elevation of the fine-grained deposit except at the eastern end where the elevation will be in the existing deposit of organic silt. All organic silt will be removed from the foundation area for

the conduit and replaced with compacted sand fill. Wherever the conduit is to be founded on silty fine sand and fine sandy silt, a zone of at least 2 feet thick of compacted sand fill will be provided for a working base. No provisions for seepage control are required for any of the structures.

32. Concrete Water Barrier. - The concrete water barrier will be constructed in the vicinity of the American Brass Company Hydroplant at the location shown on Plate No. 6-3. Foundation explorations and final design of the structure have not been completed. Since the bedrock surface is shallow in the area of the structure, it is anticipated that the structure will be founded on bedrock.

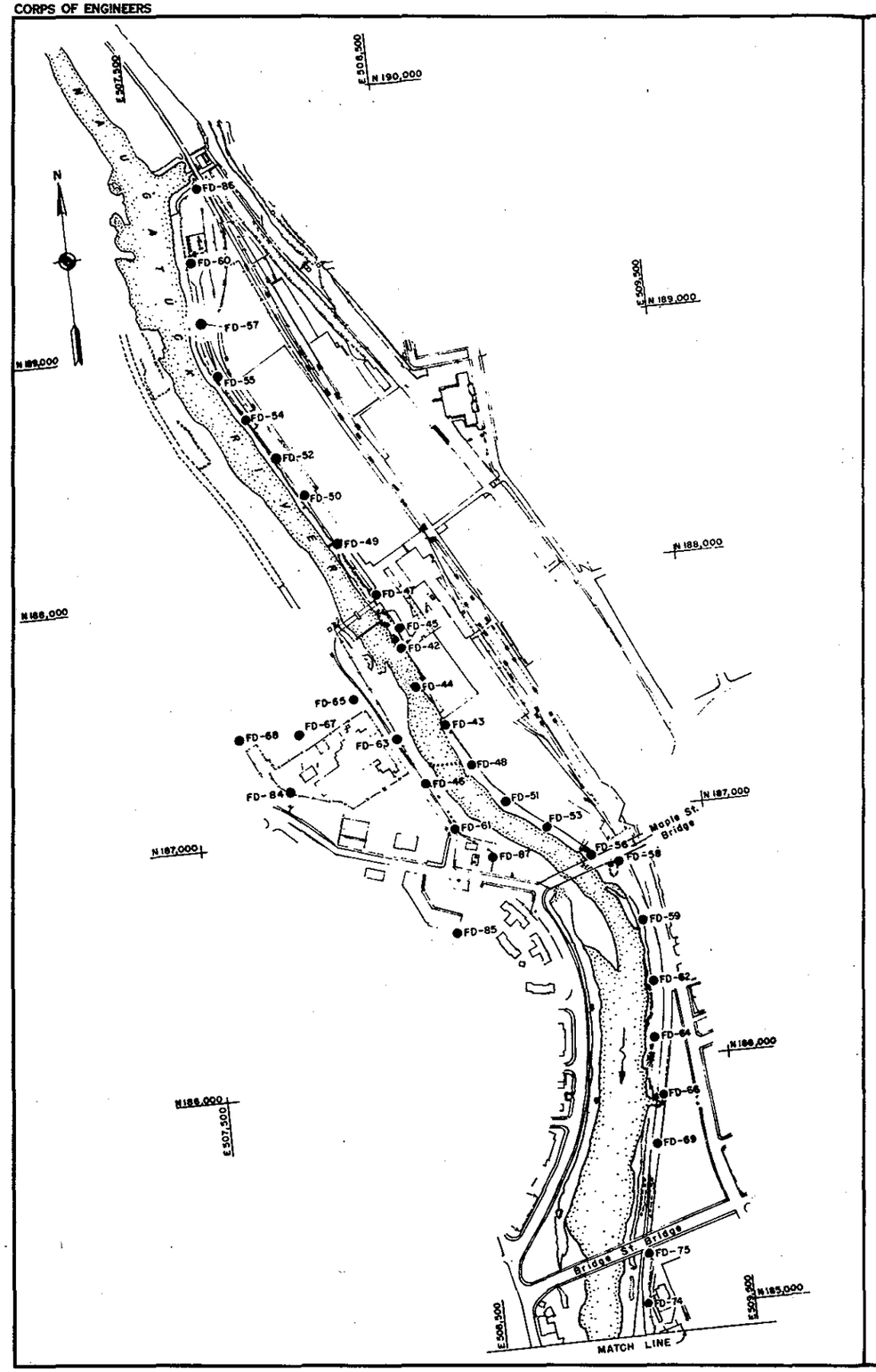


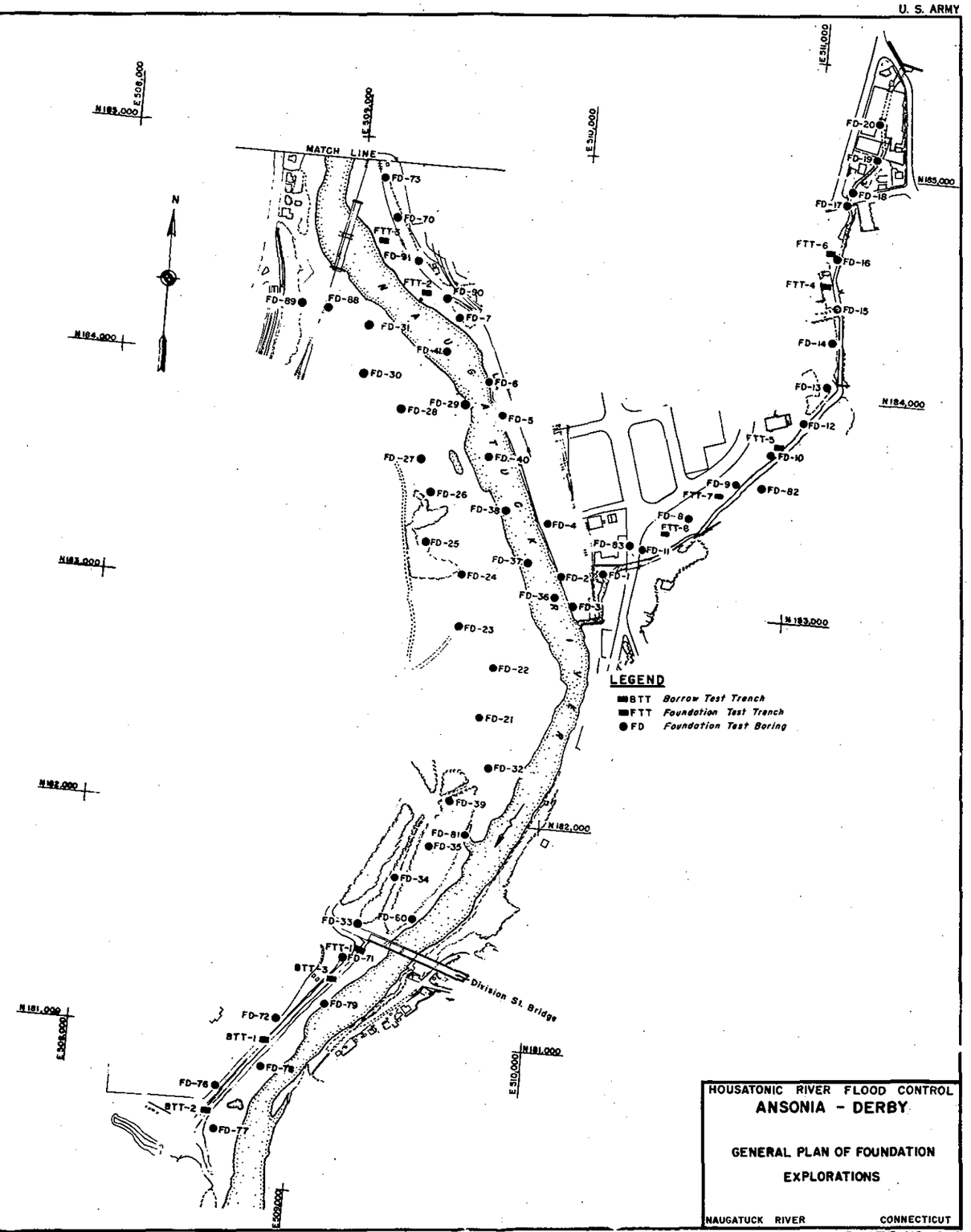
CORPS OF ENGINEERS
U. S. ARMY
DIVISION STREET BRIDGE (CONCRETE)
CHANNEL WIDENING AND STONE PROTECTION
NAUGATUCK RIVER
LIMIT OF NEW RIVER CHANNEL
RIP RAP CHANNEL
DIVISION ST. PUMPING STA.
CITY OF ANSONIA
CITY OF DERBY
PARKING AREA FOR OUTDOOR THEATER
DIKE
RAILROAD GATE NO. 5
STREET GATE NO. 4
APPROXIMATE LIMIT OF FLOODING - AUG. 1955
RELOCATED BEAVER BROOK
ROADWAY GRATING
CONCRETE BOX CONDUIT
STILLING BASIN
CONCRETE WALL
CONCRETE CONDUIT
DOWNTOWN URBAN RENEWAL PROJECT
ACCESS ROAD
FRONT ST. EXTENSION (BY OTHERS)
CONCRETE OUTLET STRUCTURE
FRONT ST. PUMPING STA.
RAILROAD GATE NO. 3
NEW RIVER CHANNEL
MAPLE ST. PUMPING STA.
RAILROAD GATE NO. 2
CONCRETE WALLS
RAILROAD GATE NO. 4
RIP RAP CHANNEL
BROAD ST. URBAN RENEWAL PROJECT
STREET GATE NO. 3
WESTSIDE SHOPPING CENTER
AMERICAN BRASS CO.
FARREL CO.
CONCRETE BARRIER
STREET GATE NO. 1
STREET GATE NO. 2
RIVER ST. PUMPING STA.
ANSONIA MFG. CO.
RAILROAD GATE NO. 1
VICINITY MAP
PROJECT
PLAN
SCALE: 1" = 200'
HOUSATONIC RIVER FLOOD CONTROL
ANSONIA - DERBY
GENERAL PLAN
NAUGATUCK RIVER
CONNECTICUT

PLATE NO. 6-1

CORPS OF ENGINEERS

U. S. ARMY





LEGEND

- BTT *Borrow Test Trench*
- FTT *Foundation Test Trench*
- FD *Foundation Test Boring*

HOUSATONIC RIVER FLOOD CONTROL

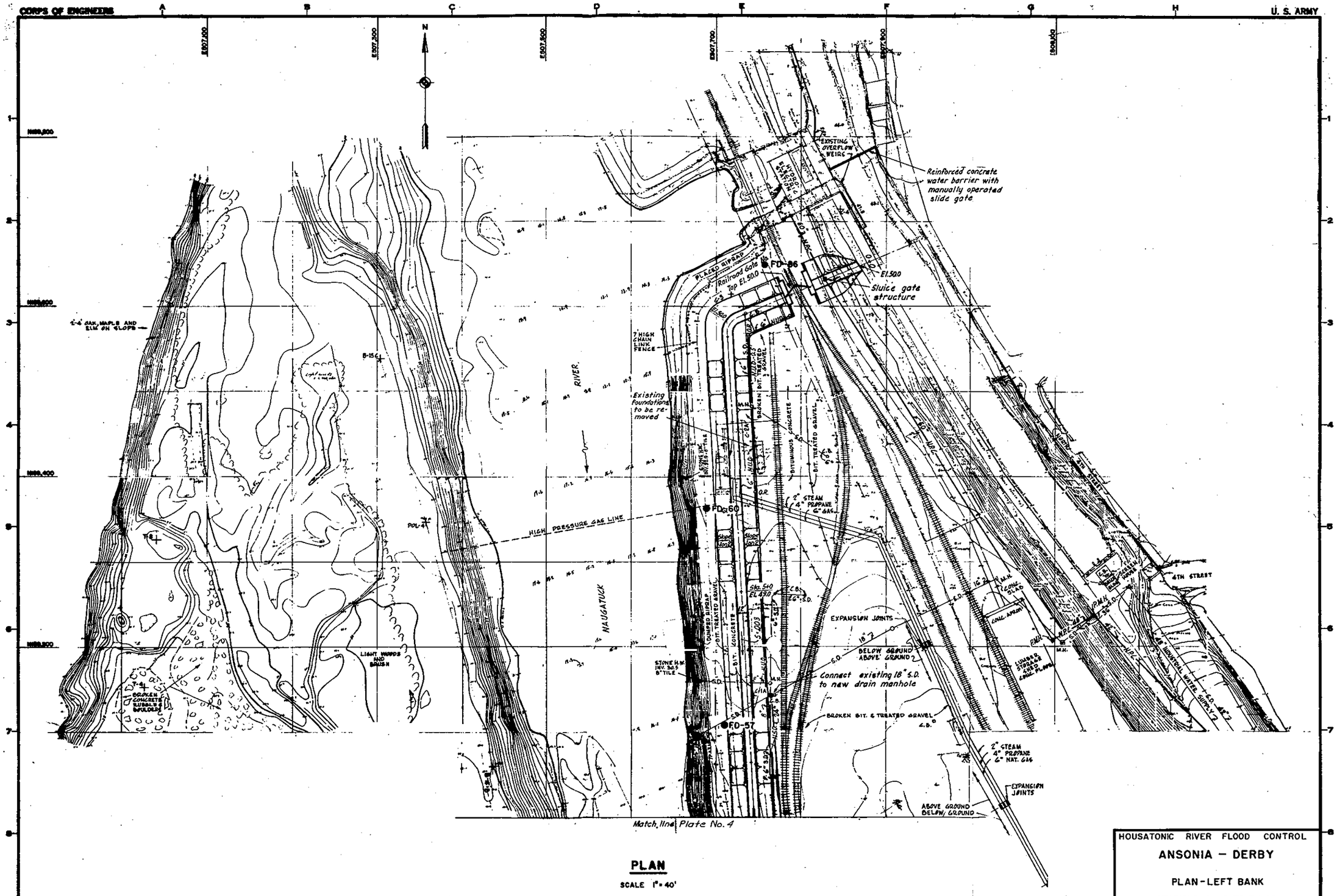
ANSONIA - DERBY

GENERAL PLAN OF FOUNDATION EXPLORATIONS

NAUGATUCK RIVER CONNECTICUT

PLATE NO. 6-2

CORPS OF ENGINEERS — U. S. ARMY



Match line Plate No. 4

PLAN

SCALE 1" = 40'

HOUSATONIC RIVER FLOOD CONTROL

ANSONIA – DERBY

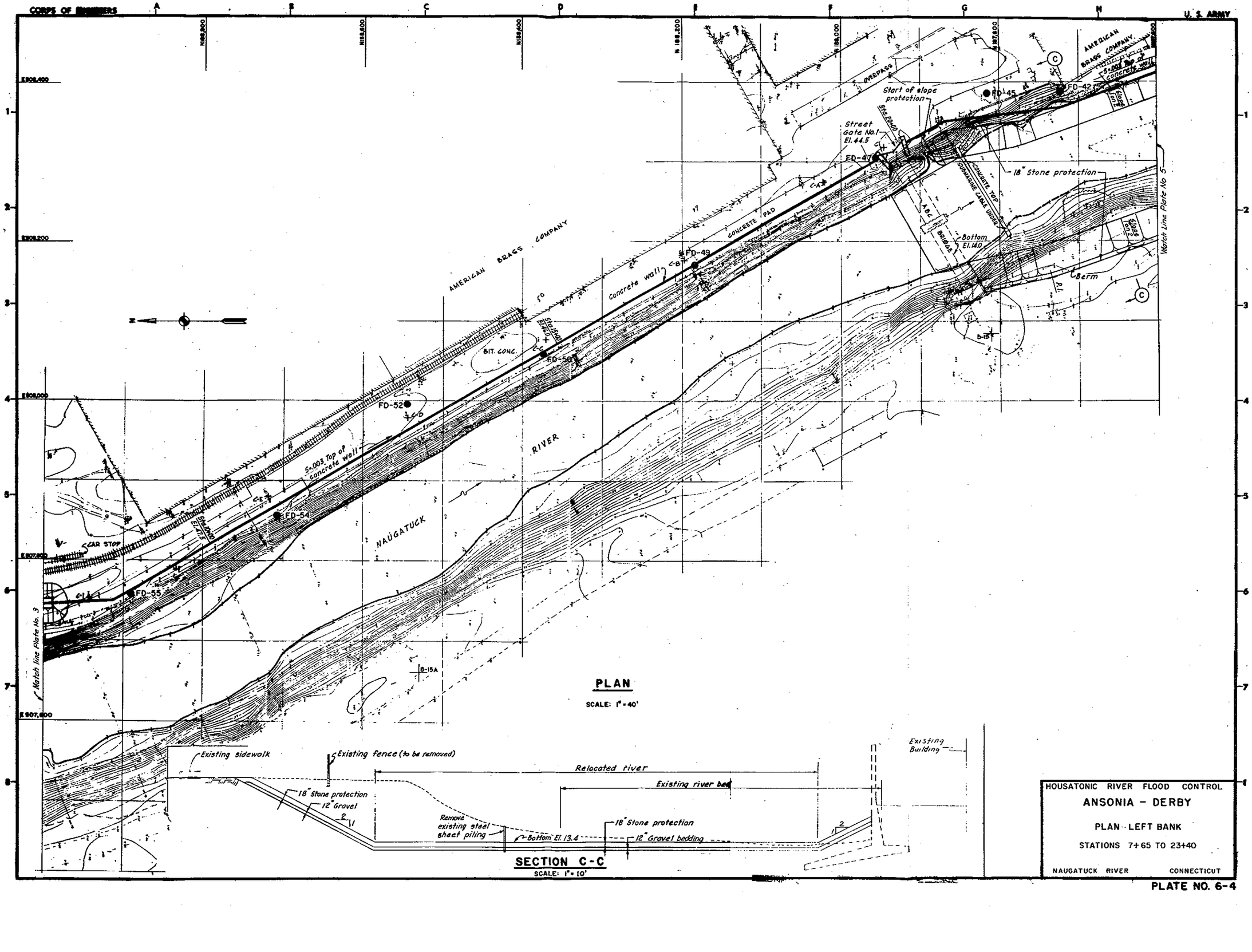
PLAN – LEFT BANK

STATIONS 0+10 TO 7+65

NAUGATUCK RIVER CONNECTICUT

PLATE NO. 6-3

CORPS OF ENGINEERS — U. S. ARMY



PLAN

SCALE: 1" = 40'

SECTION C-C

SCALE: 1" = 10'

HOUSATONIC RIVER FLOOD CONTROL

ANSONIA - DERBY

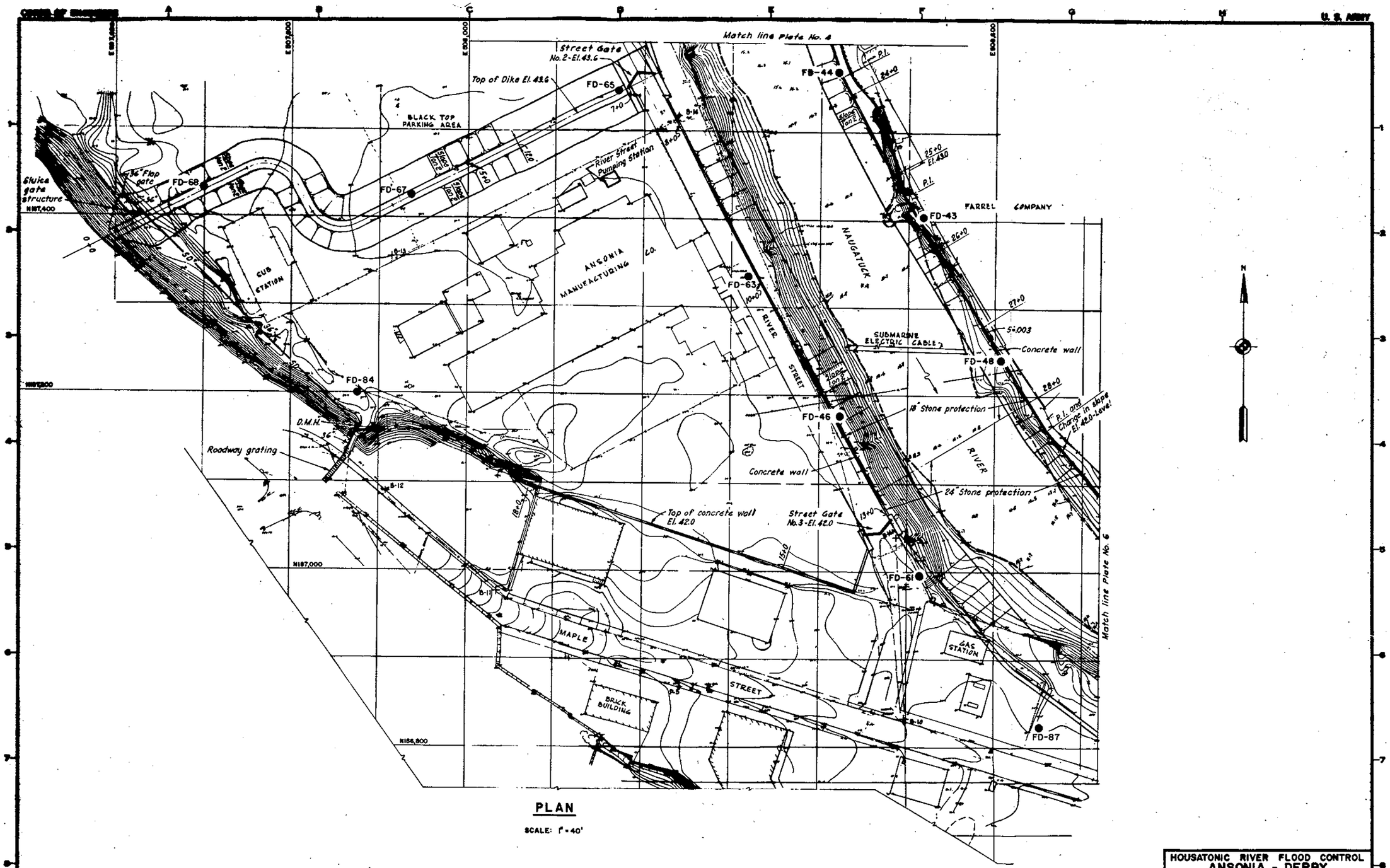
PLAN - LEFT BANK

STATIONS 7+65 TO 23+40

NAUGATUCK RIVER — CONNECTICUT

PLATE NO. 6-4

CORPS OF ENGINEERS — U. S. ARMY



PLAN

SCALE: 1" = 40'

HOUSATONIC RIVER FLOOD CONTROL
ANSONIA - DERBY

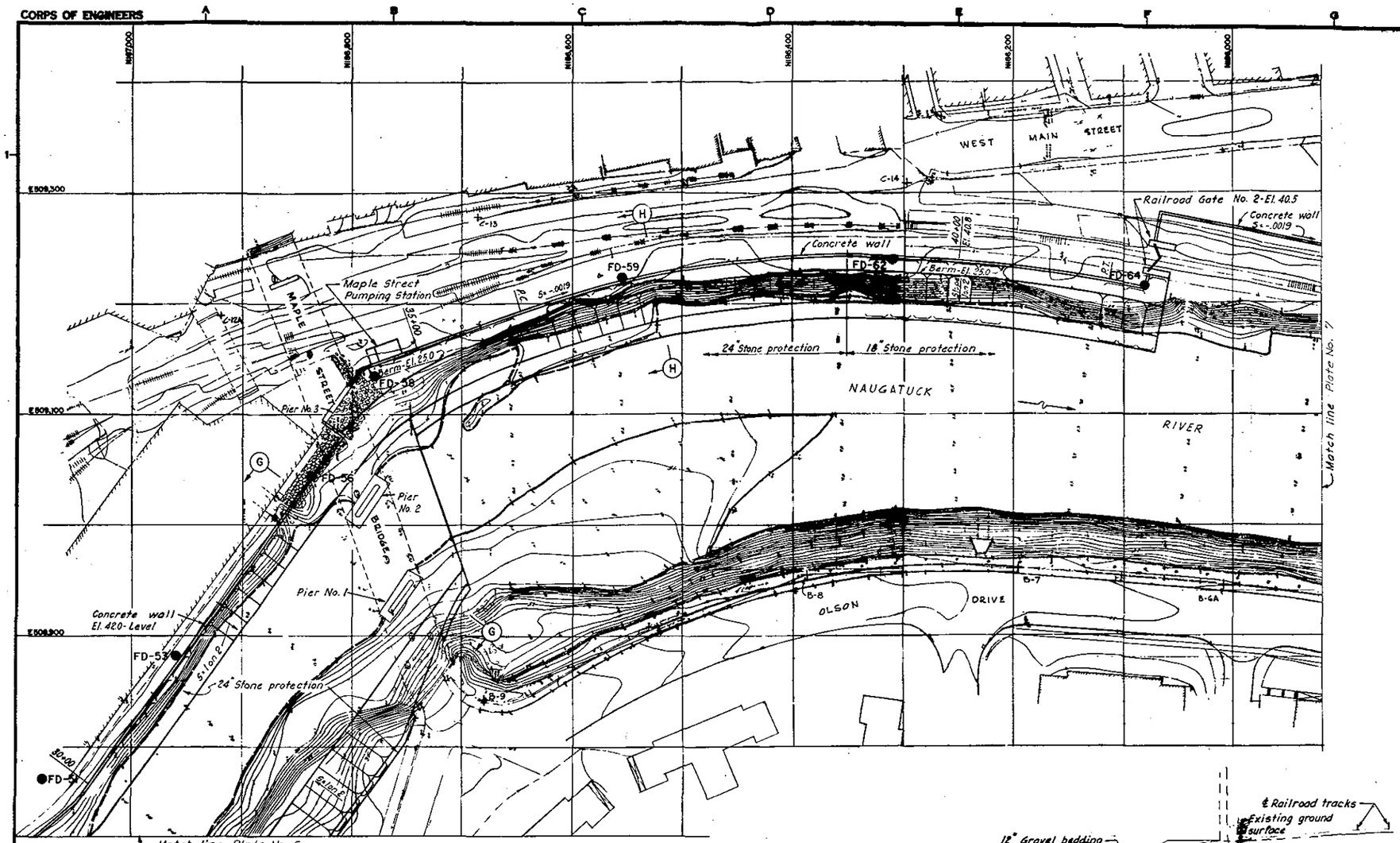
PLAN LEFT BANK AND RIGHT BANK
ANSONIA MFG. CO.
STATIONS 23+40 TO 29+30 (LEFT BANK)
STATIONS 0+30 TO 17+50 (ANSONIA MFG. CO.)

NAUGATUCK RIVER CONNECTICUT

PLATE NO. 6-5

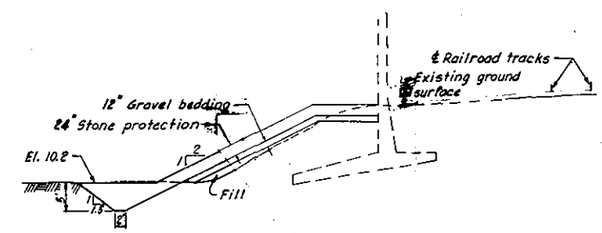
CORPS OF ENGINEERS

U. S. ARMY



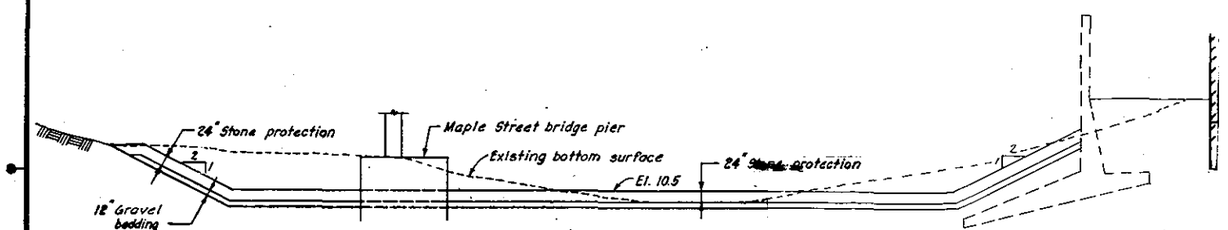
PLAN

SCALE: 1" = 40'



SECTION H-H

SCALE: 1" = 10'



SECTION G-G

SCALE: 1" = 10'

HOUSATONIC RIVER FLOOD CONTROL

ANSONIA - DERBY

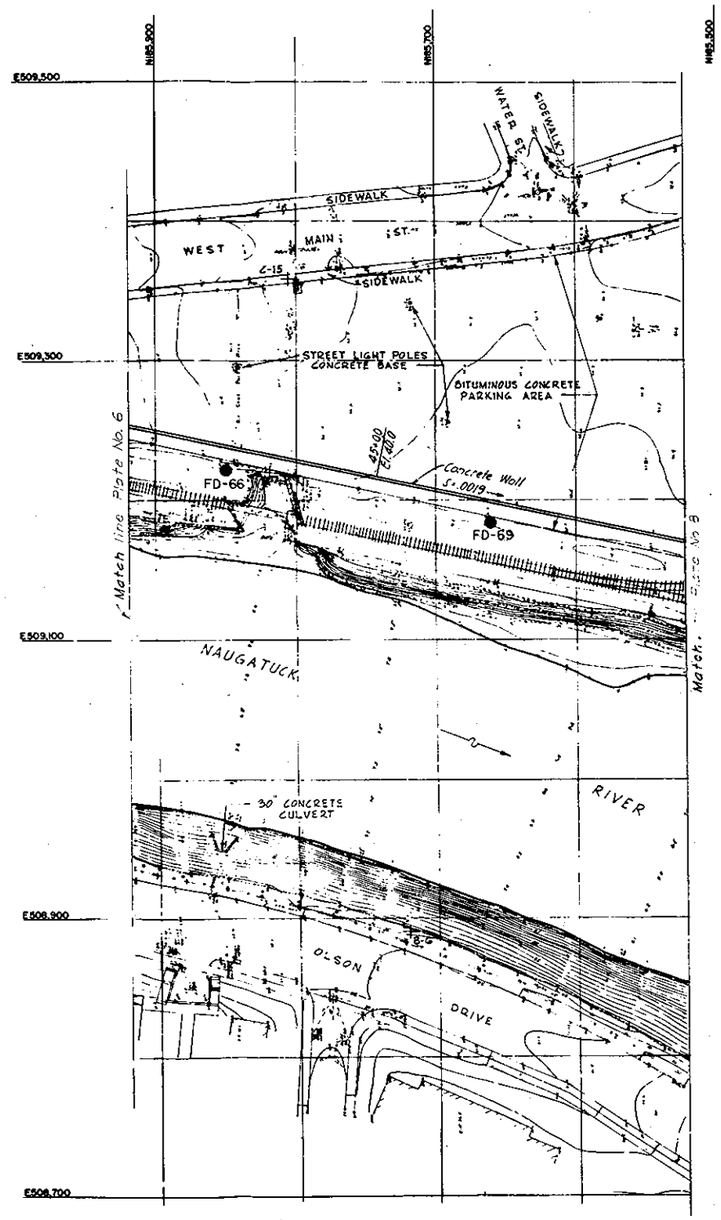
PLAN - LEFT BANK

STATIONS 29+30 TO 43+20

NAUGATUCK RIVER CONNECTICUT

PLATE NO. 6-6

CORPS OF ENGINEERS — U. S. ARMY



PLAN

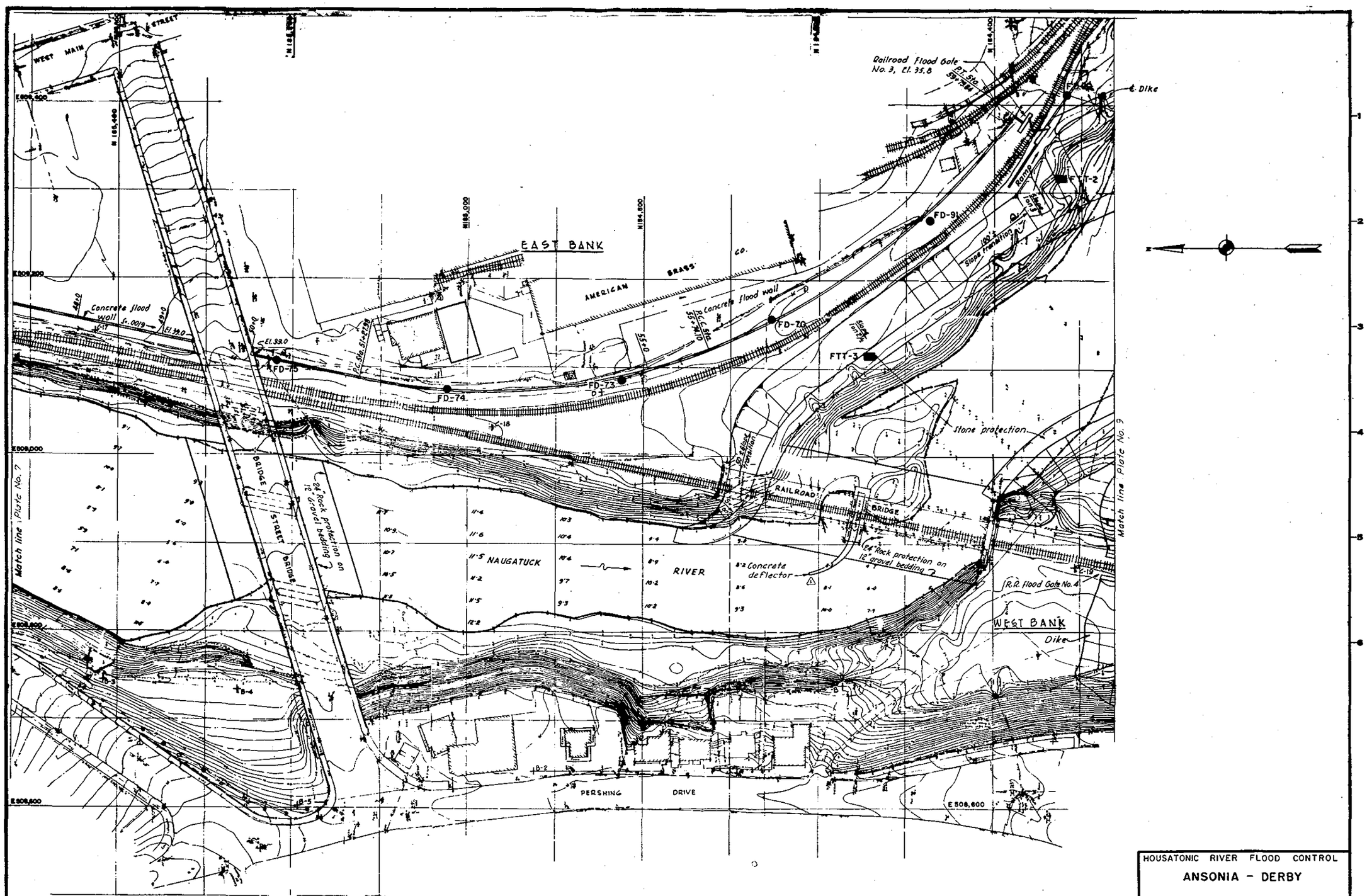
SCALE: 1" = 40'

HOUSATONIC RIVER FLOOD CONTROL
ANSONIA - DERBY

PLAN - LEFT BANK
STATIONS 43+20 TO 47+20

NAUGATUCK RIVER CONNECTICUT

PLATE NO. 6-7



HOUSATONIC RIVER FLOOD CONTROL

ANSONIA - DERBY

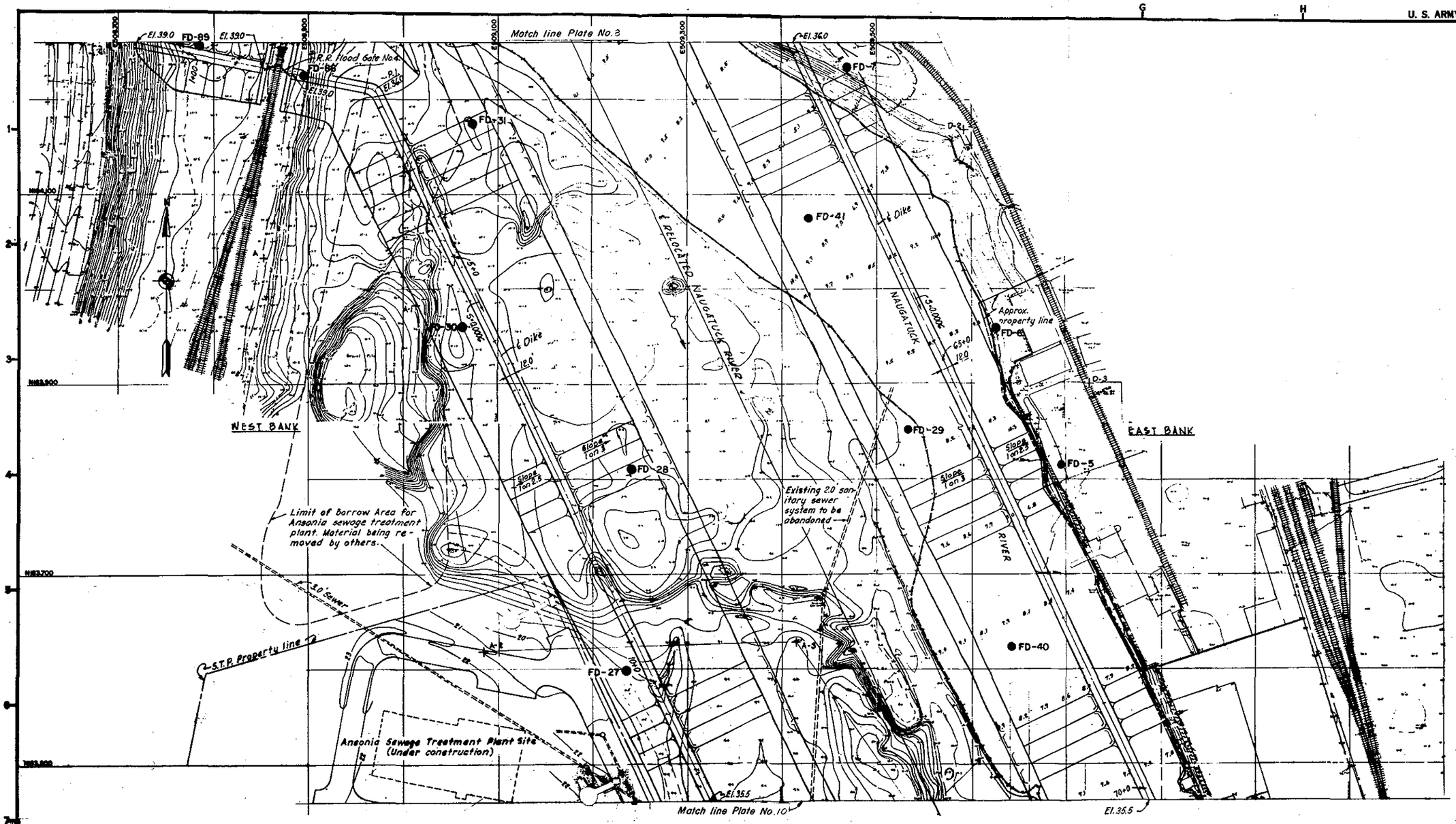
PLAN - LEFT BANK

STATIONS 47+20 TO 61+30

NAUGATUCK RIVER CONNECTICUT

PLATE NO. 6-8

U. S. ARMY



PLAN

SCALE: 1" = 40'

HOUSATONIC RIVER FLOOD CONTROL

ANSONIA - DERBY

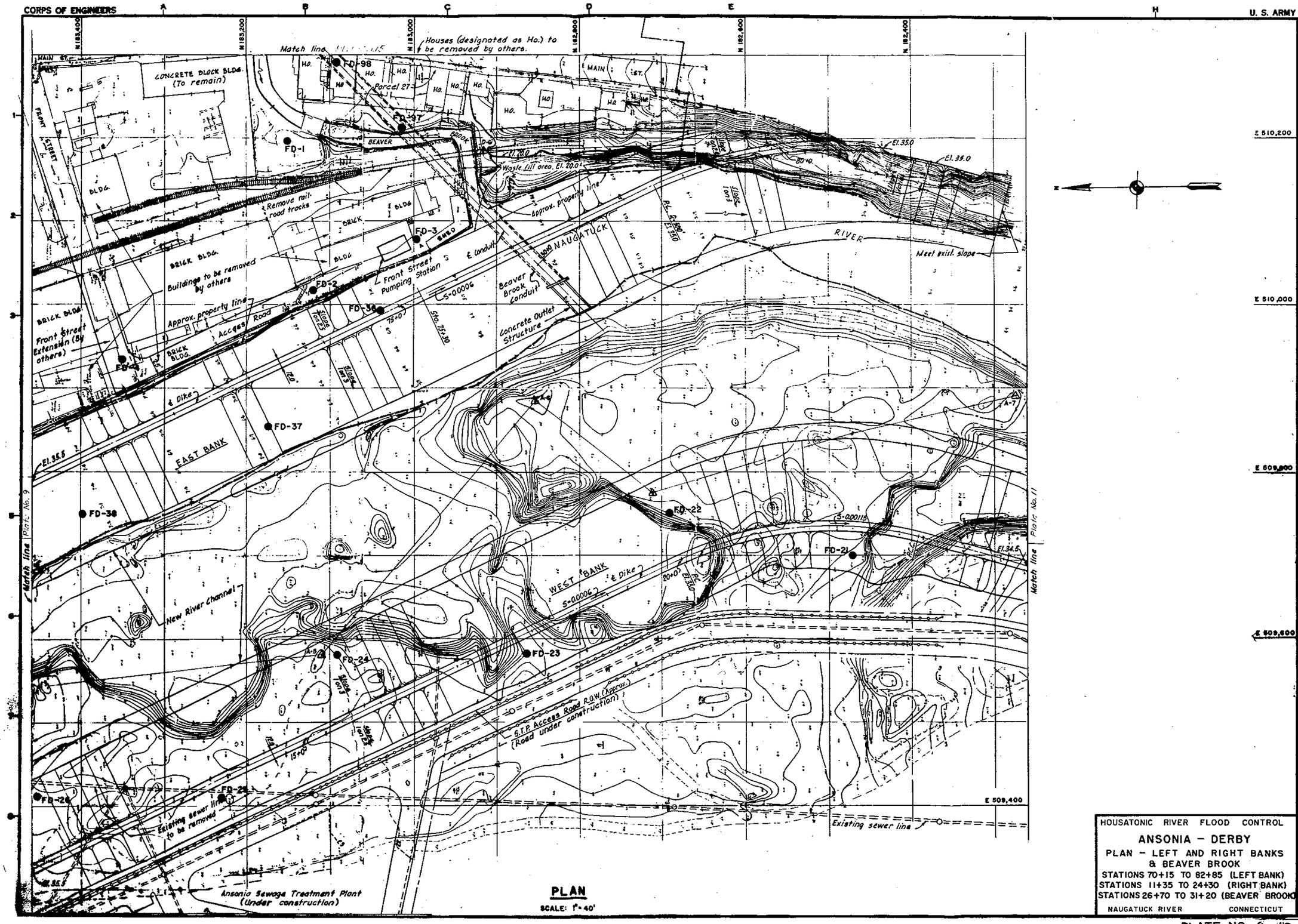
PLAN - LEFT AND RIGHT BANKS
STATIONS 61+30 TO 70+15 (LEFT BANK)
STATIONS 0+50 TO 11+35 (RIGHT BANK)

NAUGATUCK RIVER CONNECTICUT

PLATE NO. 9

CORPS OF ENGINEERS

U. S. ARMY



PLAN

SCALE: 1"=40'

HOUSATONIC RIVER FLOOD CONTROL

ANSONIA – DERBY

PLAN – LEFT AND RIGHT BANKS & BEAVER BROOK

STATIONS 70+15 TO 82+85 (LEFT BANK)

STATIONS 11+35 TO 24+30 (RIGHT BANK)

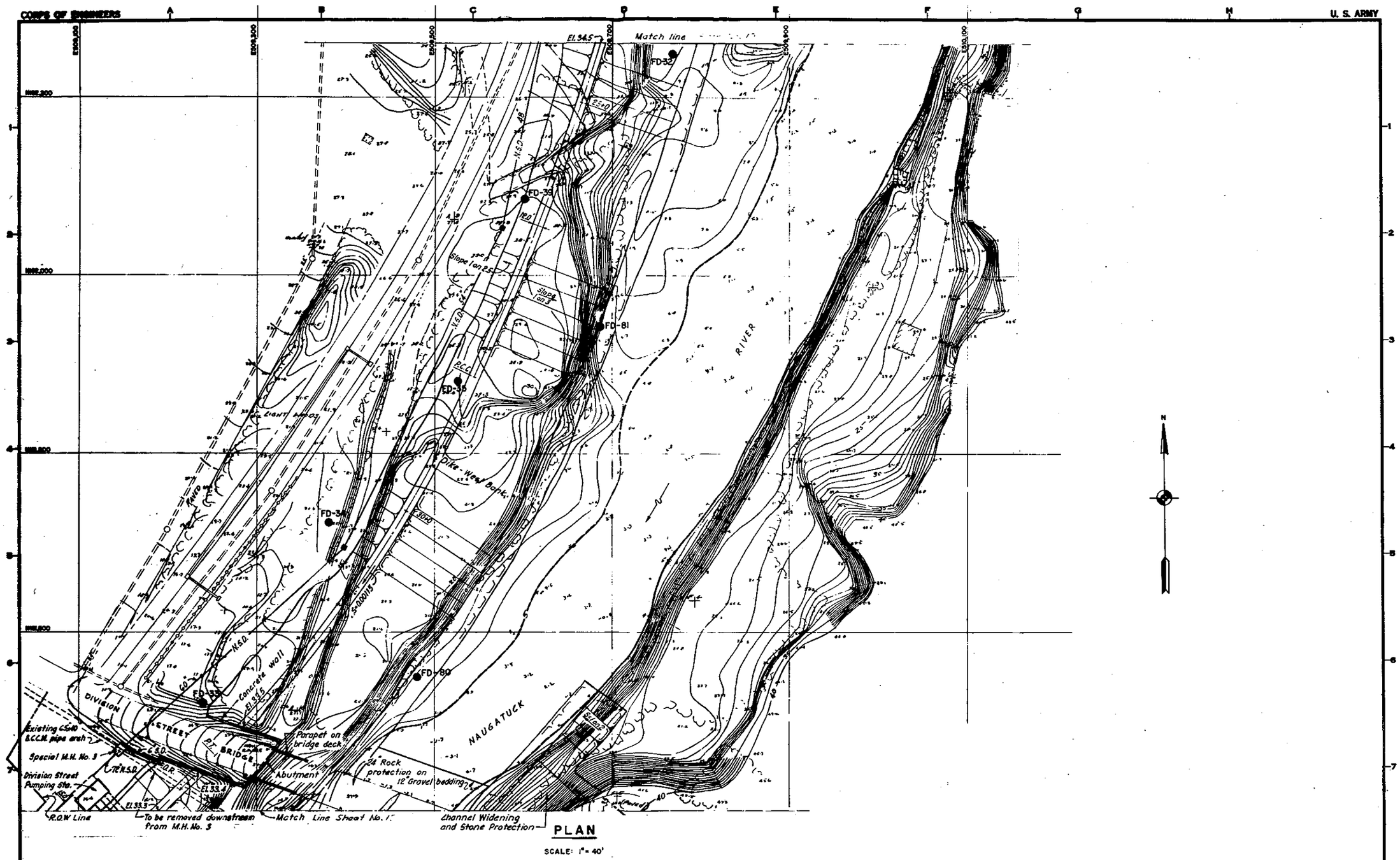
STATIONS 26+70 TO 31+20 (BEAVER BROOK)

NAUGATUCK RIVER CONNECTICUT

PLATE NO. 6-110

CORPS OF ENGINEERS

U. S. ARMY



HOUSATONIC RIVER FLOOD CONTROL

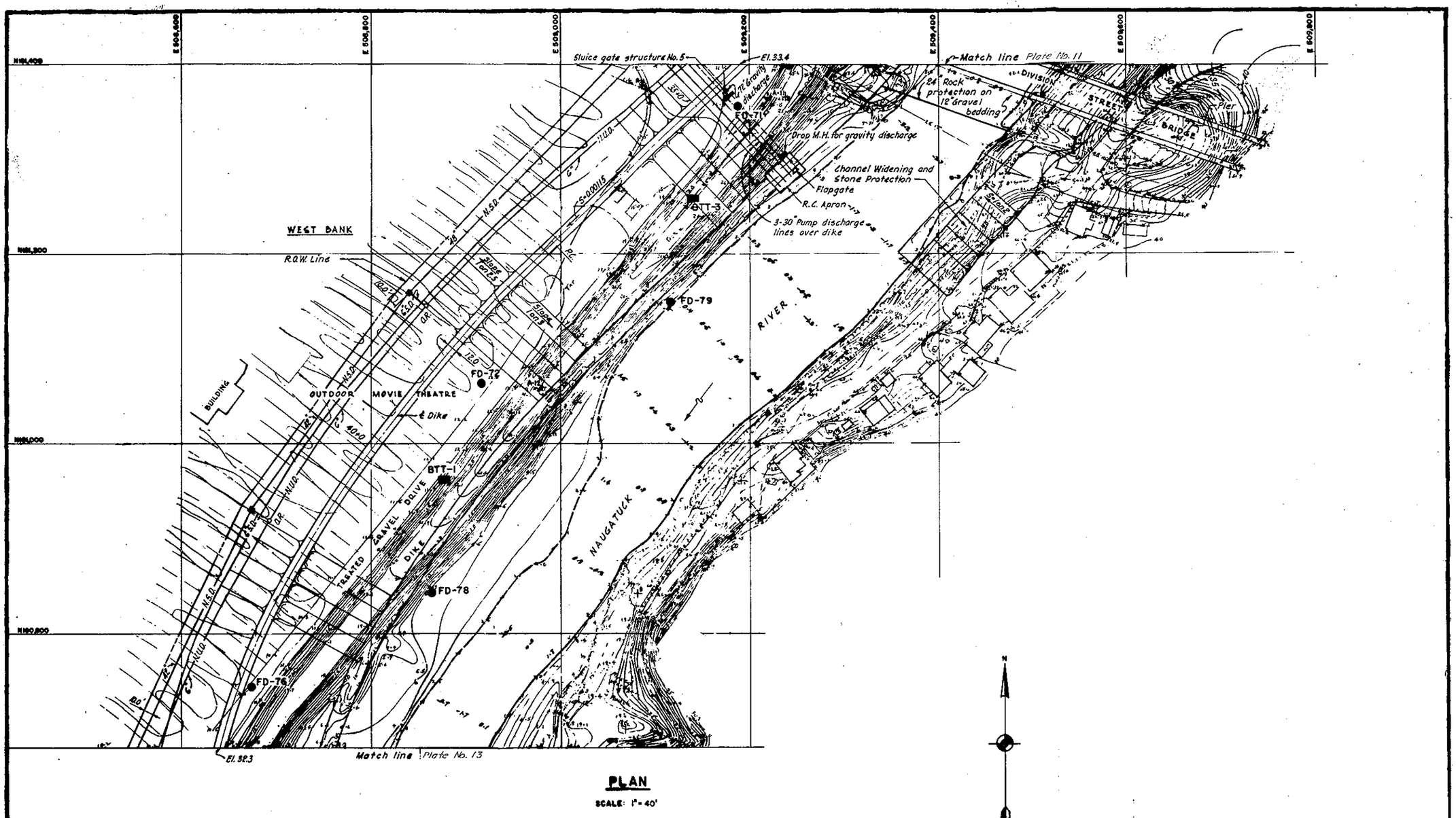
ANSONIA – DERBY

PLAN – RIGHT BANK

STATIONS 24+30 TO 34+30

NAUGATUCK RIVER CONNECTICUT

PLATE NO. 6-11



PLAN

SCALE: 1" = 40'

HOUSATONIC RIVER FLOOD CONTROL

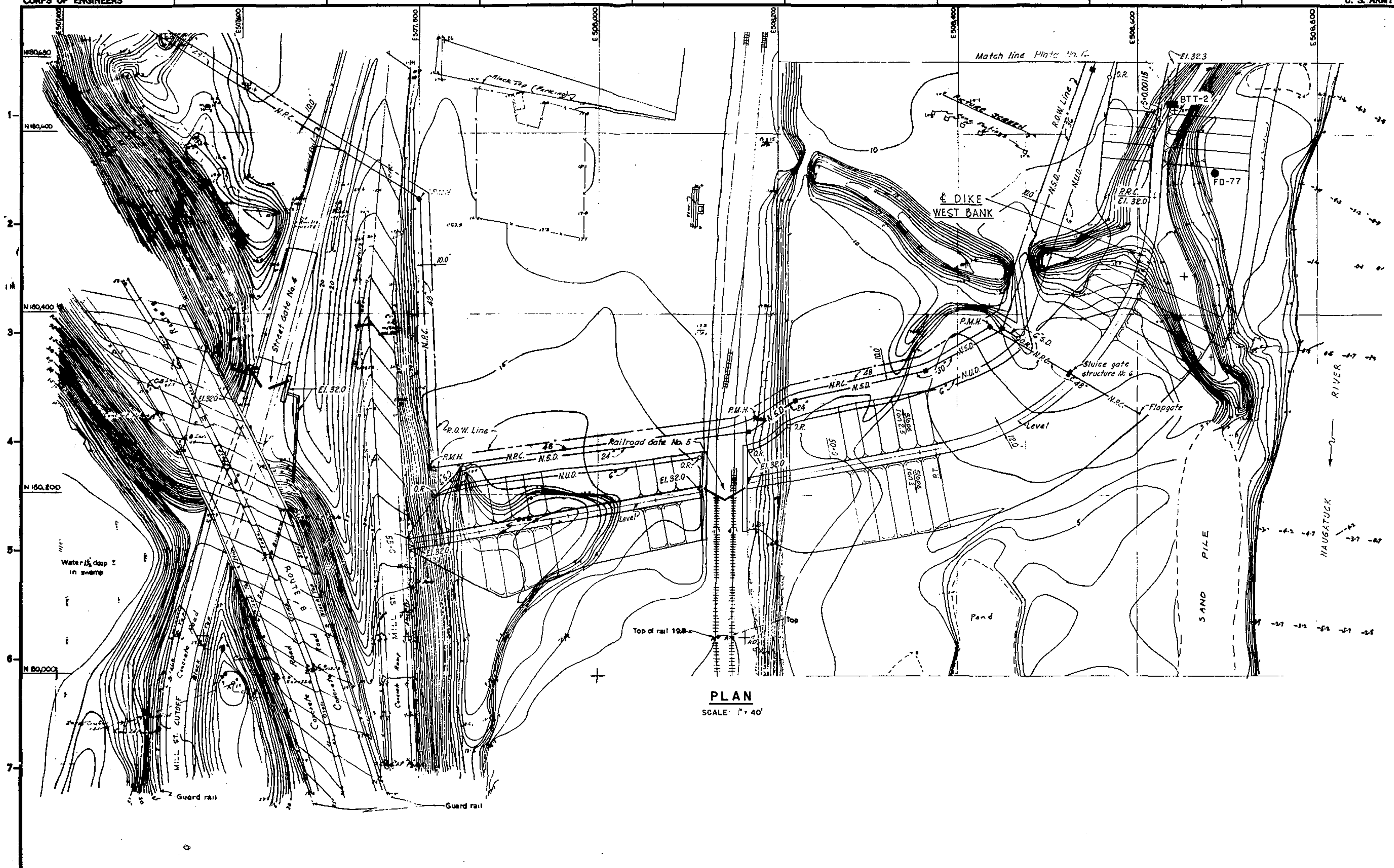
ANSONIA – DERBY

PLAN – RIGHT BANK

STATIONS 34+30 TO 43+56

NAUGATUCK RIVER CONNECTICUT

PLATE NO. 6-12



HOUSATONIC RIVER FLOOD CONTROL

ANSONIA – DERBY

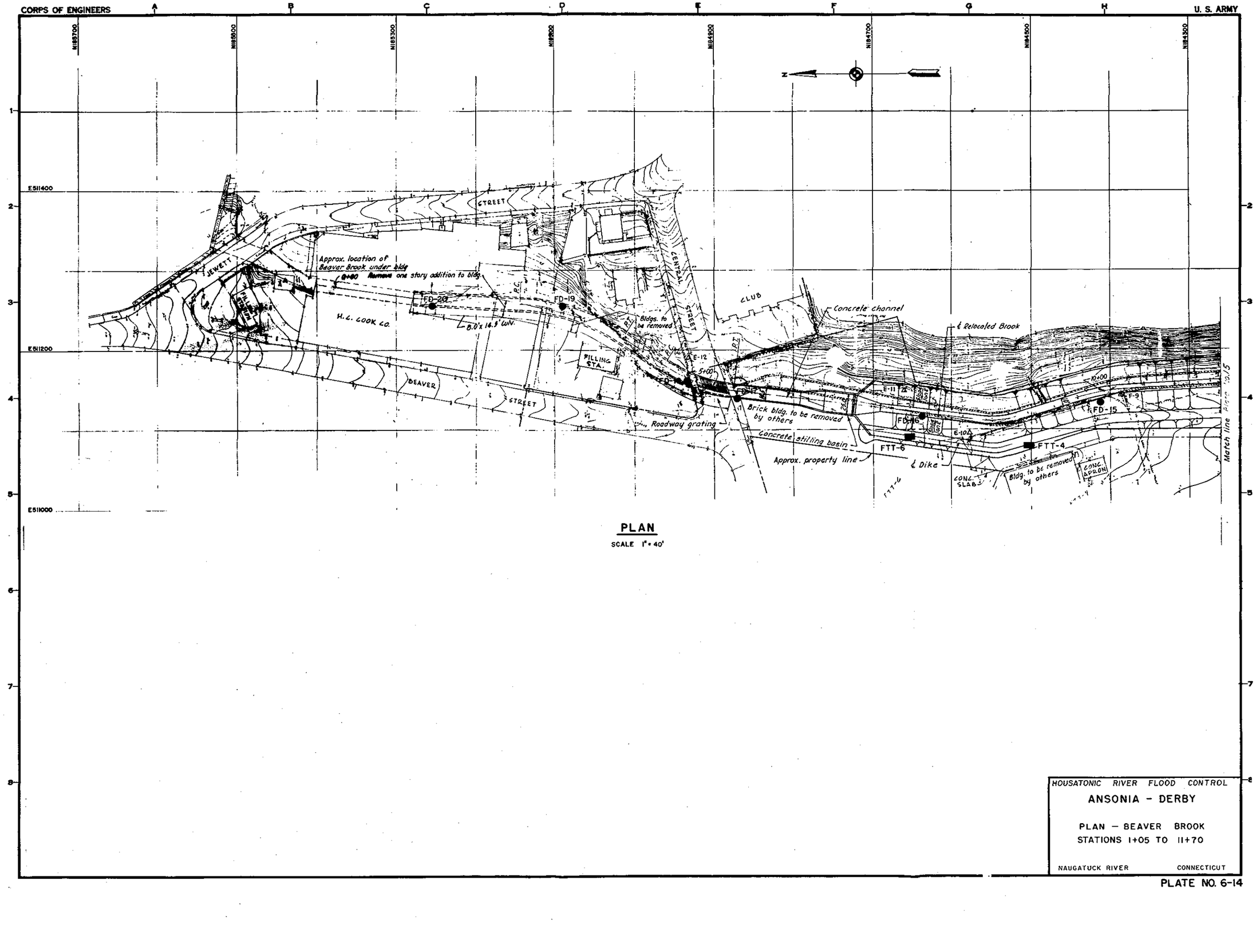
PLAN – RIGHT BANK
STATIONS 43+56 TO 54+80

NAUGATUCK RIVER — CONNECTICUT

PLATE NO. 6-13

CORPS OF ENGINEERS

U. S. ARMY



PLAN

SCALE 1" = 40'

HOUSATONIC RIVER FLOOD CONTROL

ANSONIA - DERBY

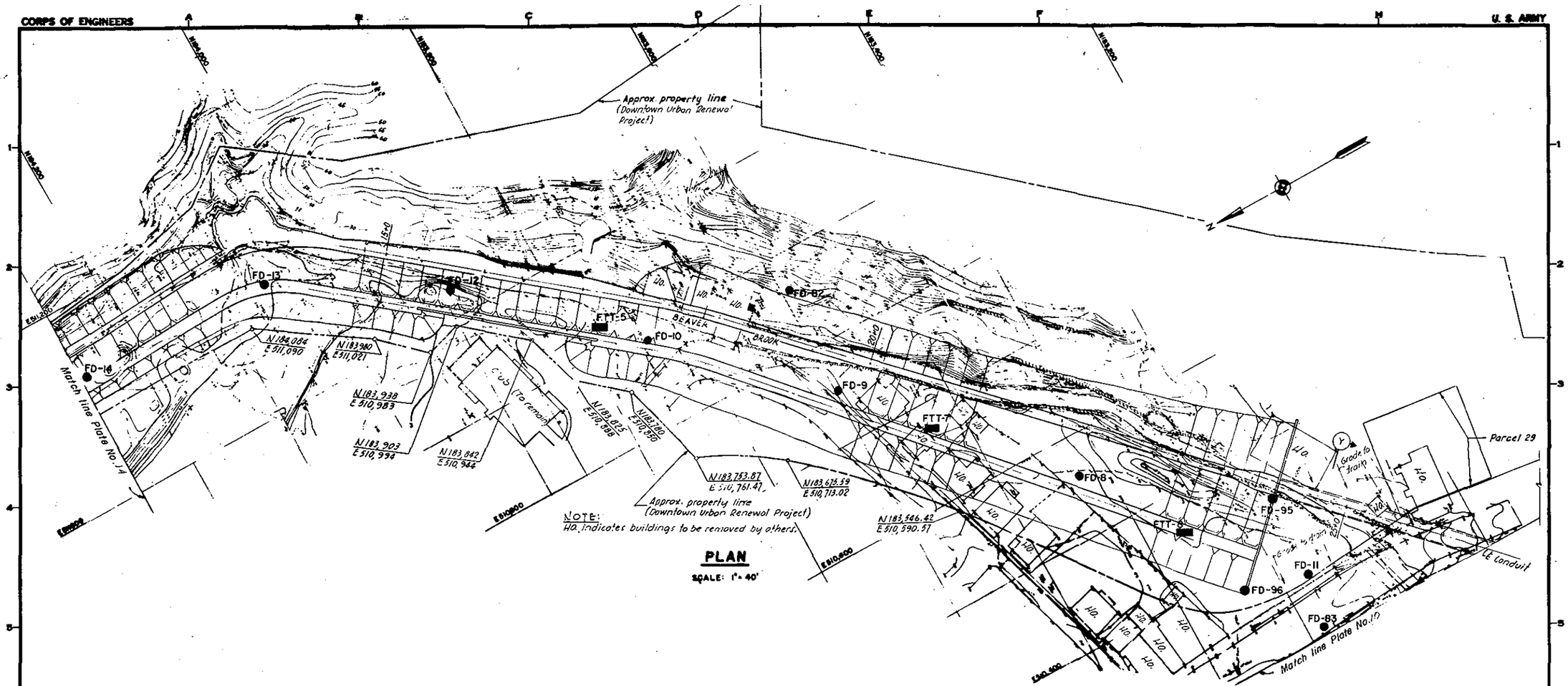
PLAN — BEAVER BROOK
STATIONS 1+05 TO 11+70

NAUGATUCK RIVER CONNECTICUT

PLATE NO. 6-14

CORPS OF ENGINEERS

U. S. ARMY



NOTE:
HO. indicates buildings to be removed by others.

PLAN

SCALE: 1" = 40'

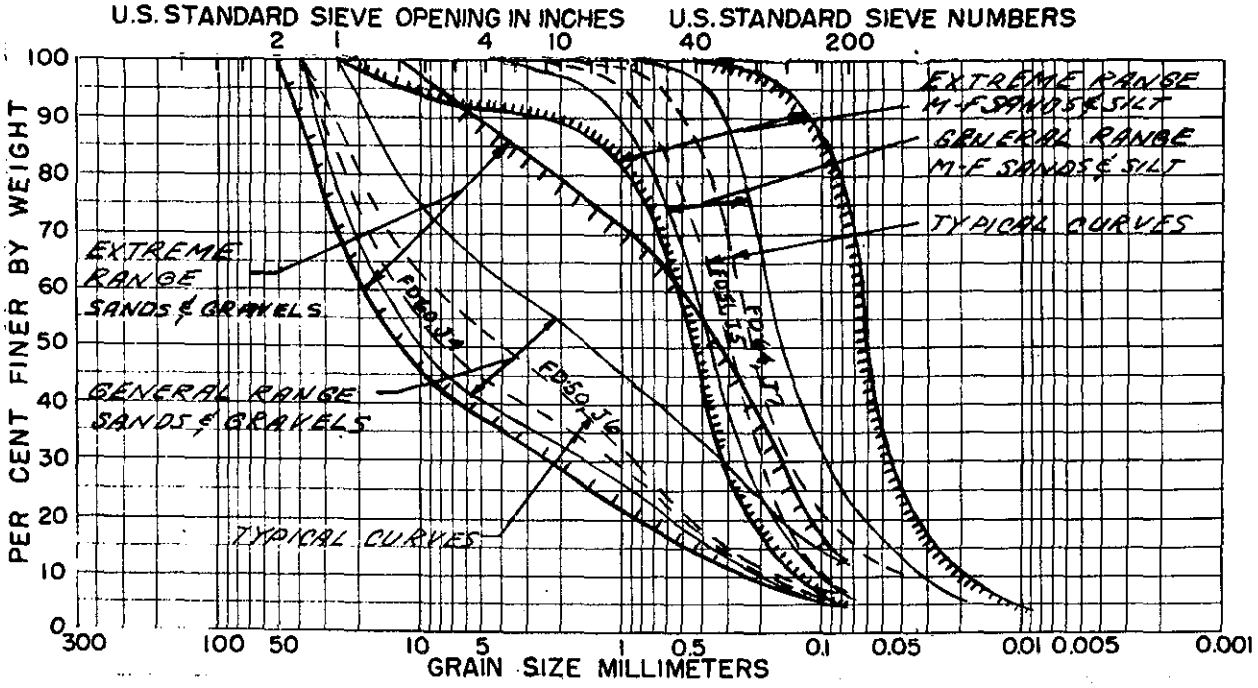
HOUSATONIC RIVER FLOOD CONTROL

ANSONIA - DERBY

PLAN - BEAVER BROOK
STATIONS 11+70 TO 26+70

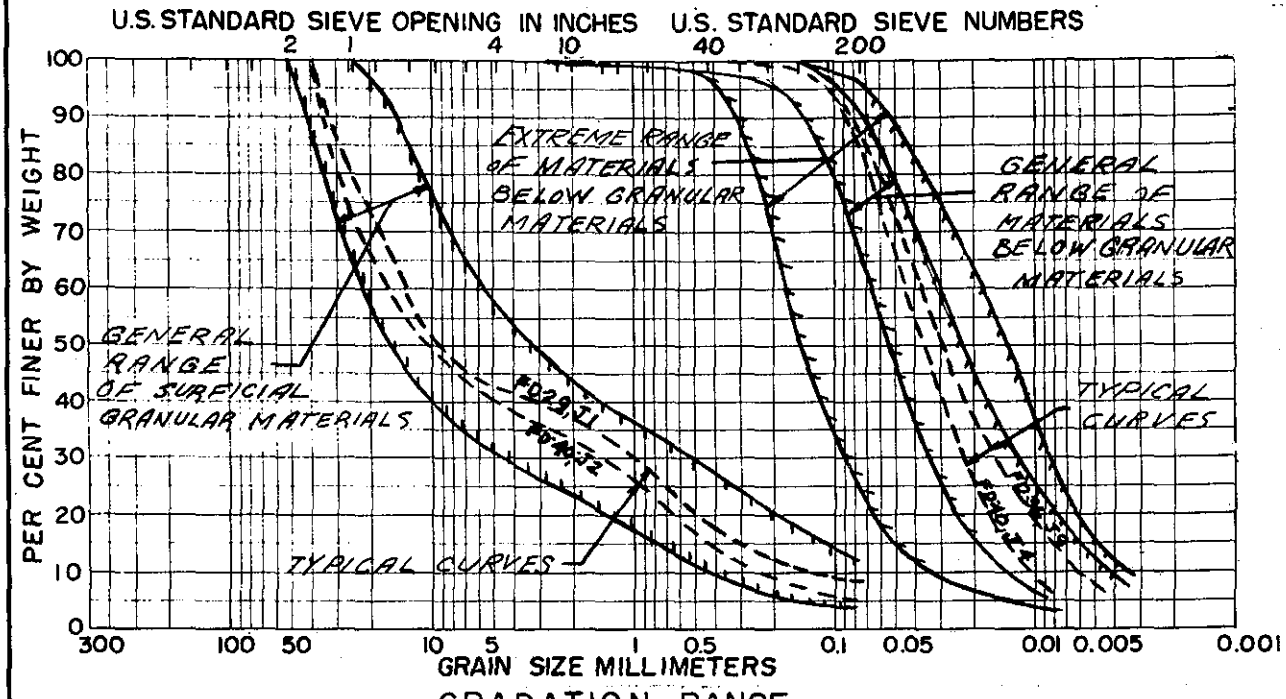
NAUGATUCK RIVER CONNECTICUT

PLATE NO. 6-15



GRADATION RANGE

STA. 0+20 TO STA. 60+70



GRADATION RANGE

STA. 60 + 70 TO STA. 82 + 75

HOUSATONIC RIVER FLOOD CONTROL

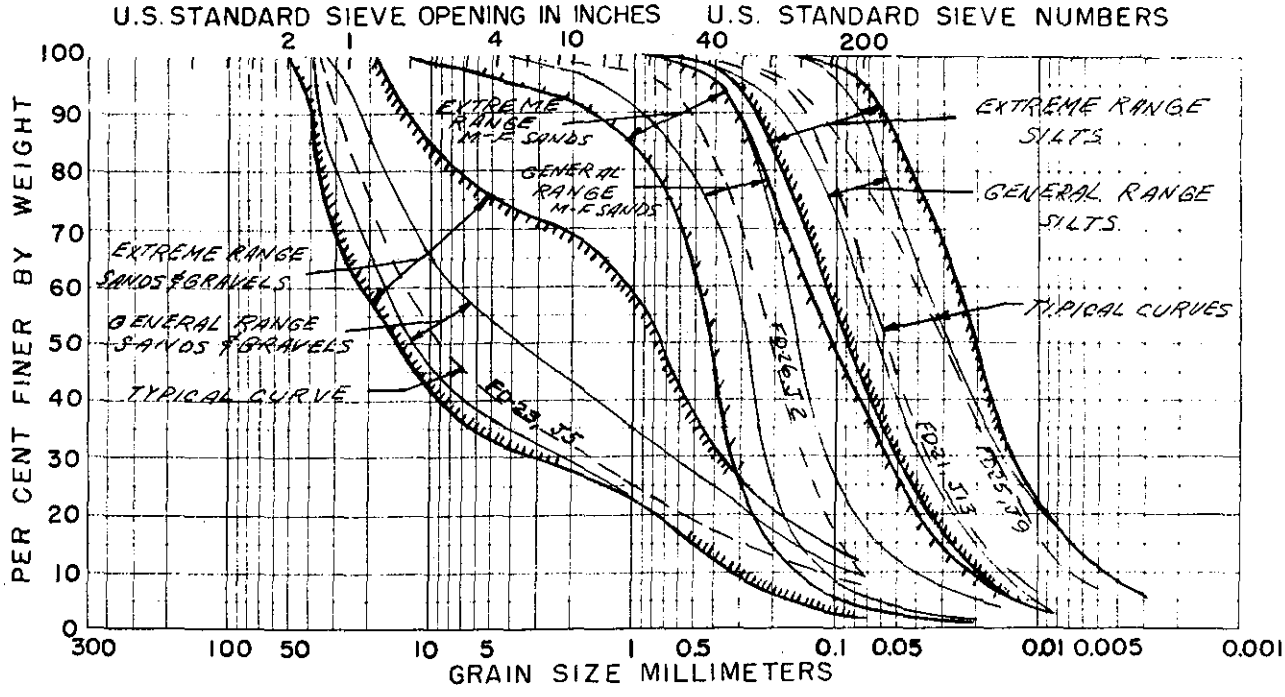
ANSONIA – DERBY

SELECTED TEST DATA
FOUNDATION – LEFT BANK

NAUGATUCK RIVER CONNECTICUT

PLATE NO. 6-16

CORPS OF ENGINEERS U.S. ARMY



GRADATION RANGE

STA. 0+50 TO STA. 55+00

HOUSATONIC RIVER FLOOD CONTROL

ANSONIA - DERBY

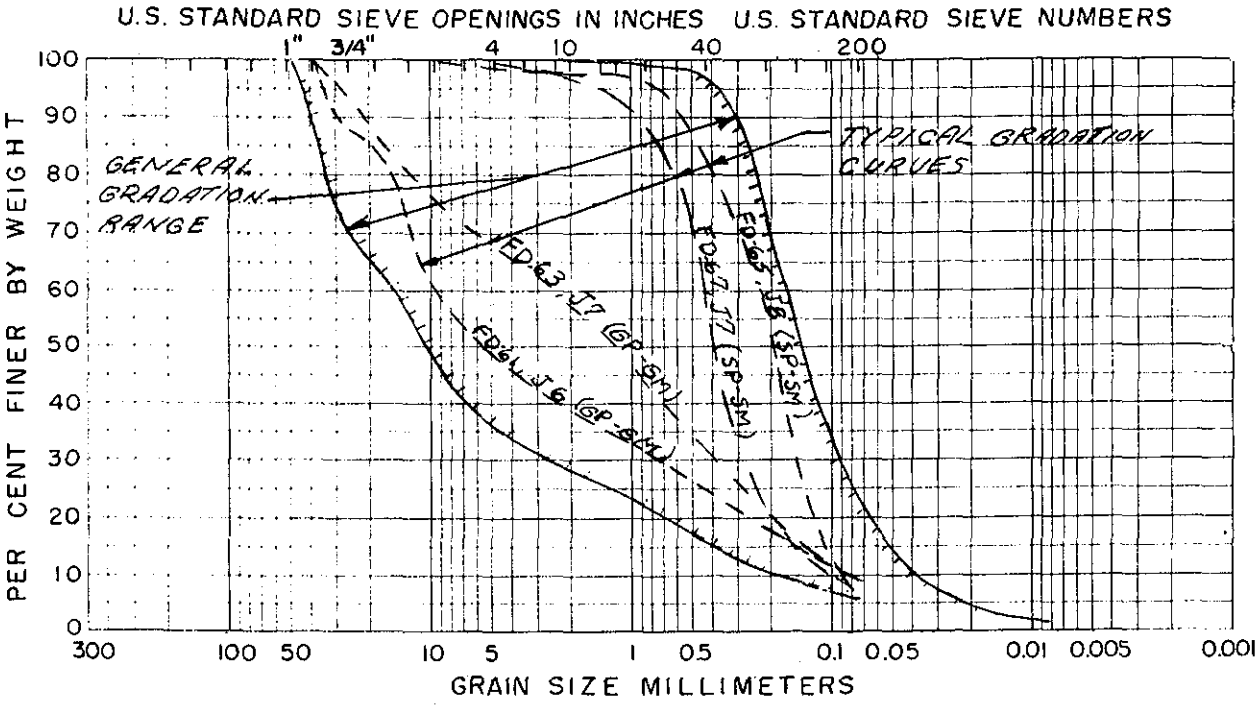
SELECTED TEST DATA

FOUNDATION — RIGHT BANK

NAUGATUCK RIVER CONNECTICUT

PLATE NO. 6-17

CORPS OF ENGINEERS U.S. ARMY



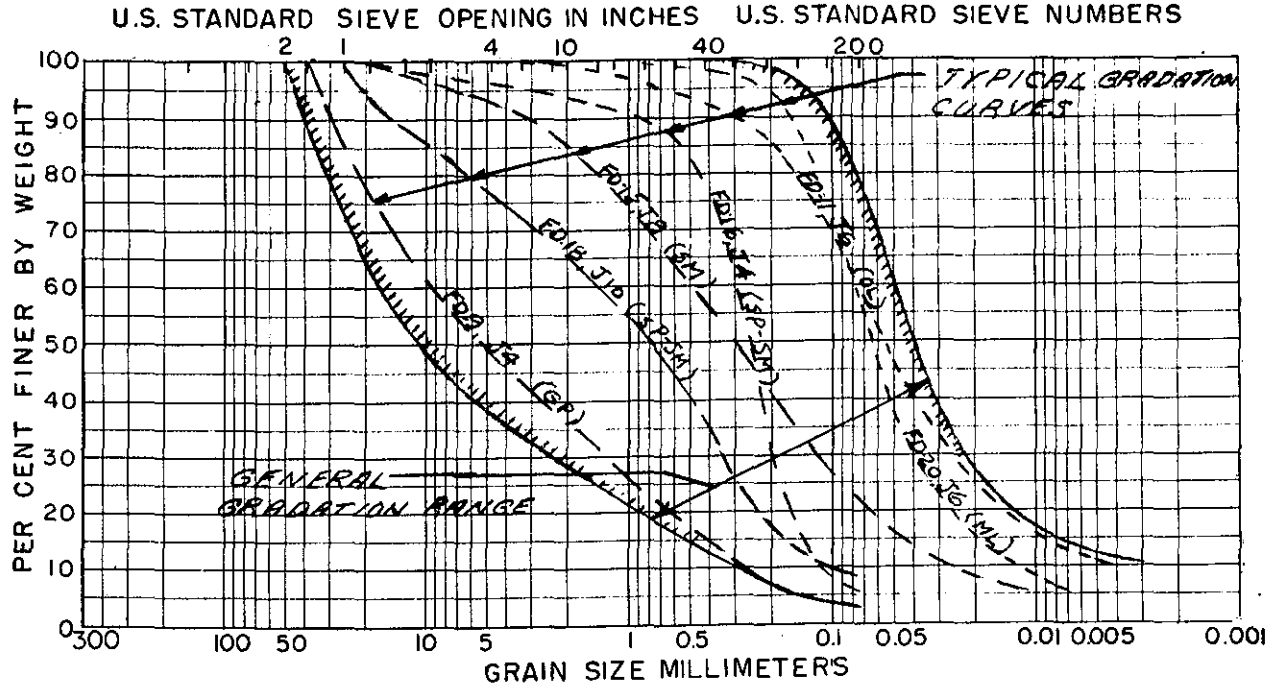
GRADATION RANGE

HOUSATONIC RIVER FLOOD CONTROL

ANSONIA — DERBY

SELECTED TEST DATA
FOUNDATION — RIGHT BANK
ANSONIA MANUFACTURING
NAUGATUCK RIVER CONNECTICUT

PLATE NO. 6-18



GRADATION RANGE

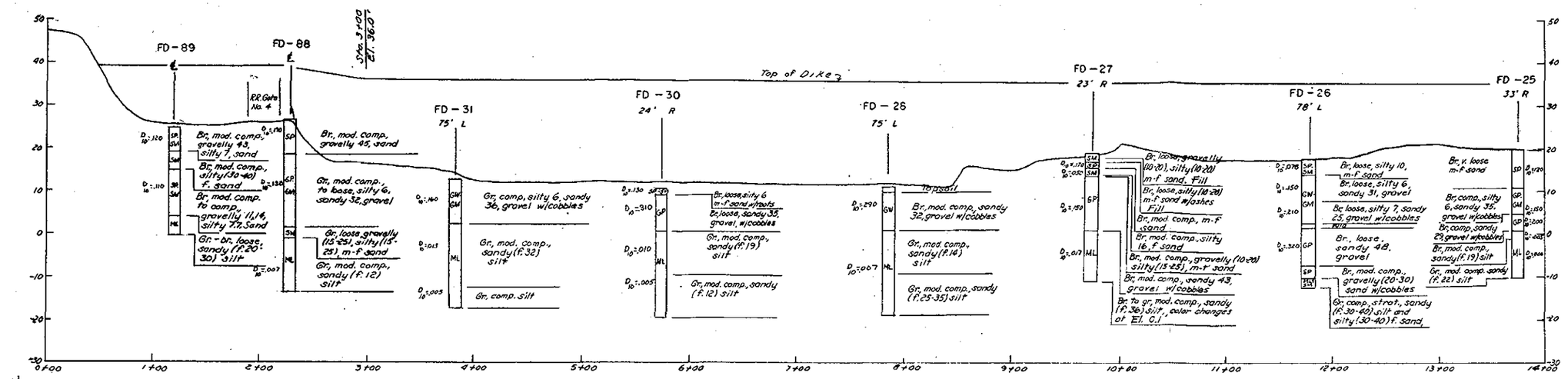
STA. 1+00 TO STA. 31+25

HOUSATONIC RIVER FLOOD CONTROL
ANSONIA - DERBY
SELECTED TEST DATA
FOUNDATION - BEAVER BROOK
NAUGATUCK RIVER CONNECTICUT

PLATE NO. 6-19

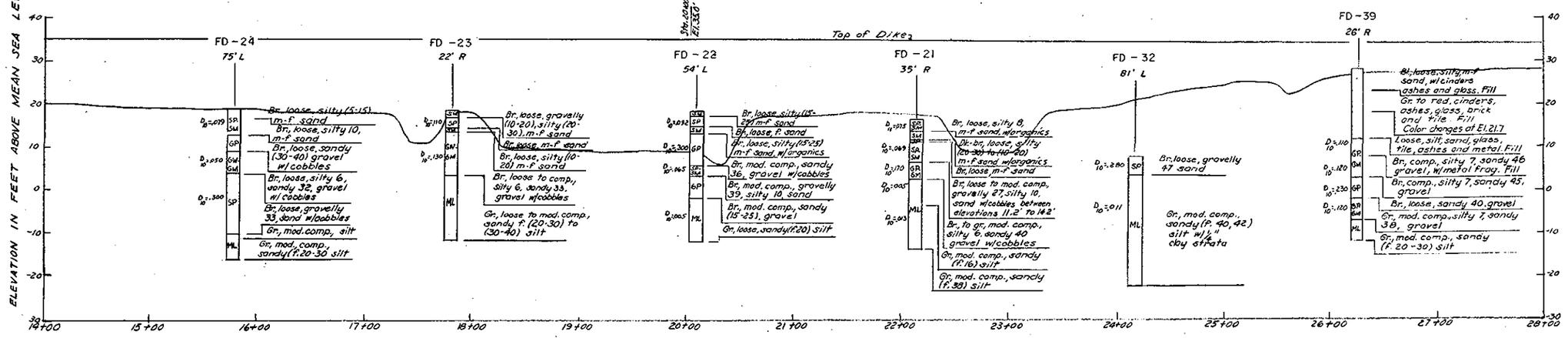
CORPS OF ENGINEERS

U. S. ARMY

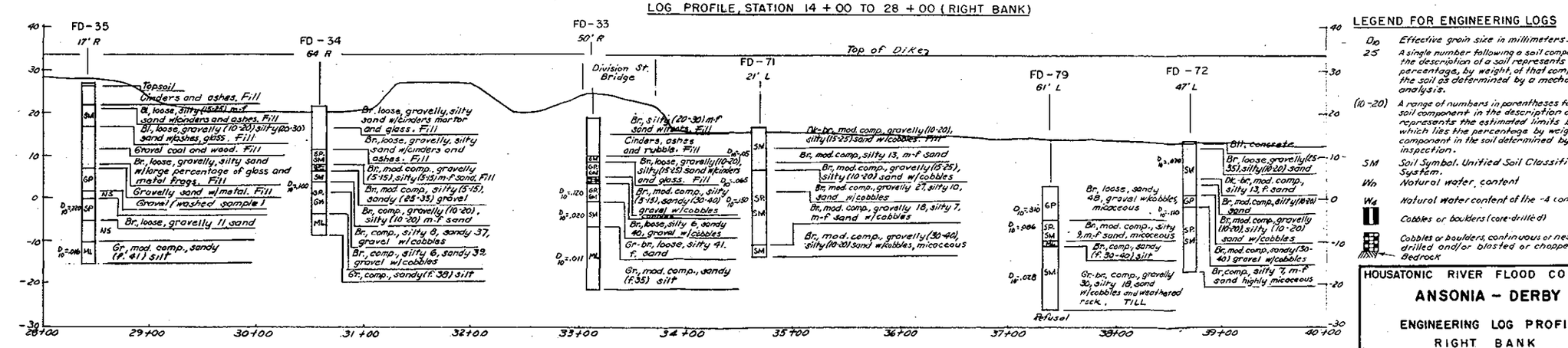


LOG PROFILE, STATION 0 + 00 TO 14 + 00 (RIGHT BANK)

ELEVATION IN FEET ABOVE MEAN SEA LEVEL



LOG PROFILE, STATION 14 + 00 TO 28 + 00 (RIGHT BANK)



LOG PROFILE, STATION 28 + 00 TO 40 + 00 (RIGHT BANK)

LEGEND FOR ENGINEERING LOGS

- D_{10} — Effective grain size in millimeters.
- 25 — A single number following a soil component in the description of a soil represents the percentage, by weight, of that component in the soil as determined by a mechanical analysis.
- (10-20) — A range of numbers in parentheses following a soil component in the description of a soil, represents the estimated limits between which lies the percentage by weight of that component in the soil determined by visual inspection.
- SM — Soil Symbol. Unified Soil Classification System.
- W_n — Natural water content
- W_4 — Natural water content of the -4 component
- Cobbles or boulders (core-drilled)
- Cobbles or boulders, continuous or nested (Core-drilled and/or blasted or chopped. Bedrock

HOUSATONIC RIVER FLOOD CONTROL

ANSONIA - DERBY

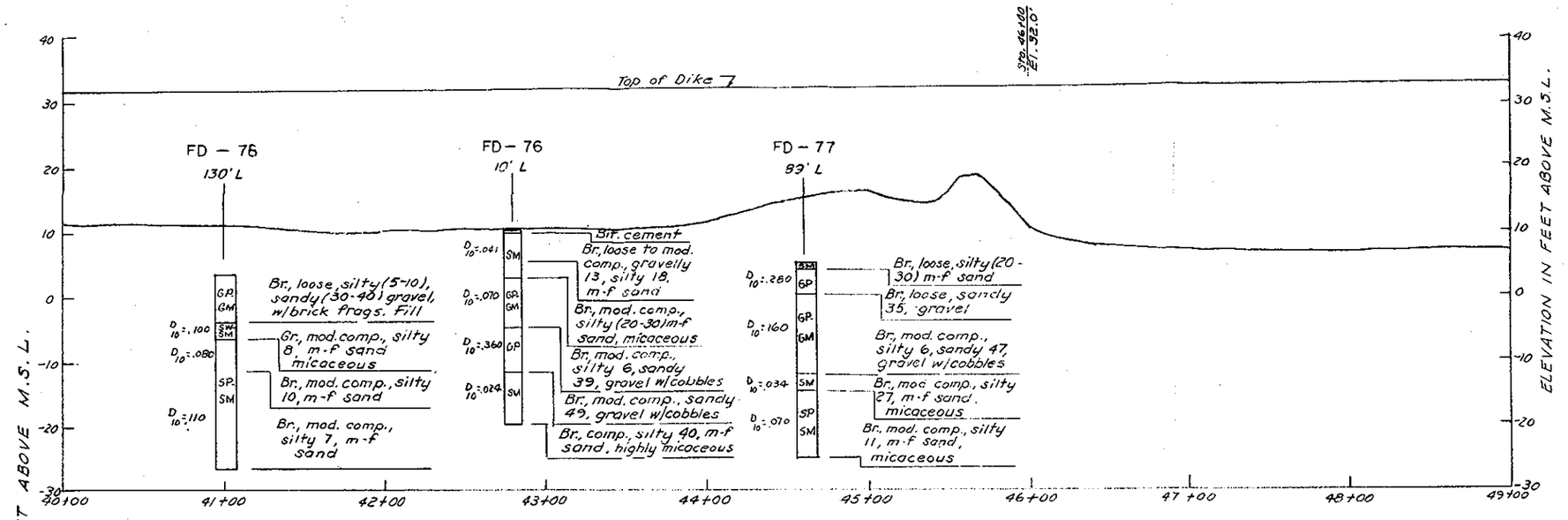
ENGINEERING LOG PROFILE

RIGHT BANK

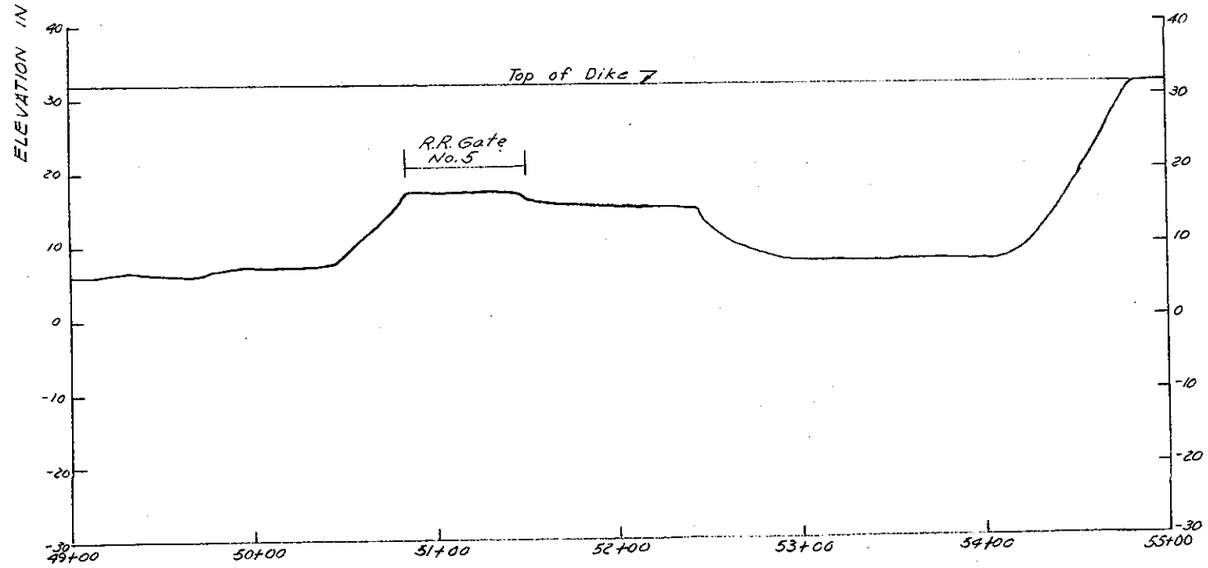
STATION 0 + 00 TO 40 + 00

NAUGATUCK RIVER — CONNECTICUT

PLATE NO. 6-20



LOG PROFILE, STATION 40 + 00 TO 49 + 00 (RIGHT BANK)



LOG PROFILE, STATION 49 + 00 TO 54 + 80 (RIGHT BANK)

HOUSATONIC RIVER FLOOD CONTROL

ANSONIA – DERBY

ENGINEERING LOG PROFILE

RIGHT BANK

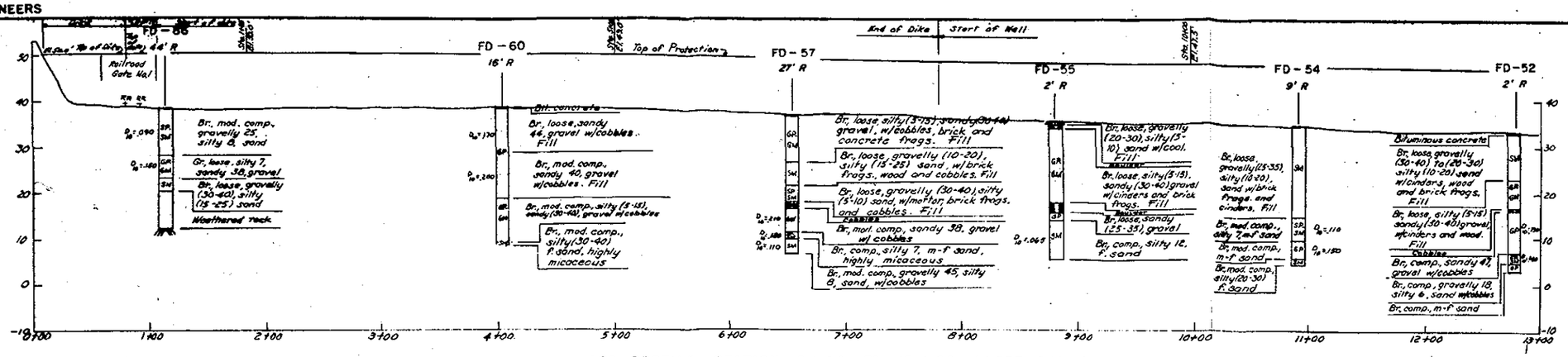
STATION 40+00 TO 54+80

NAUGATUCK RIVER CONNECTICUT

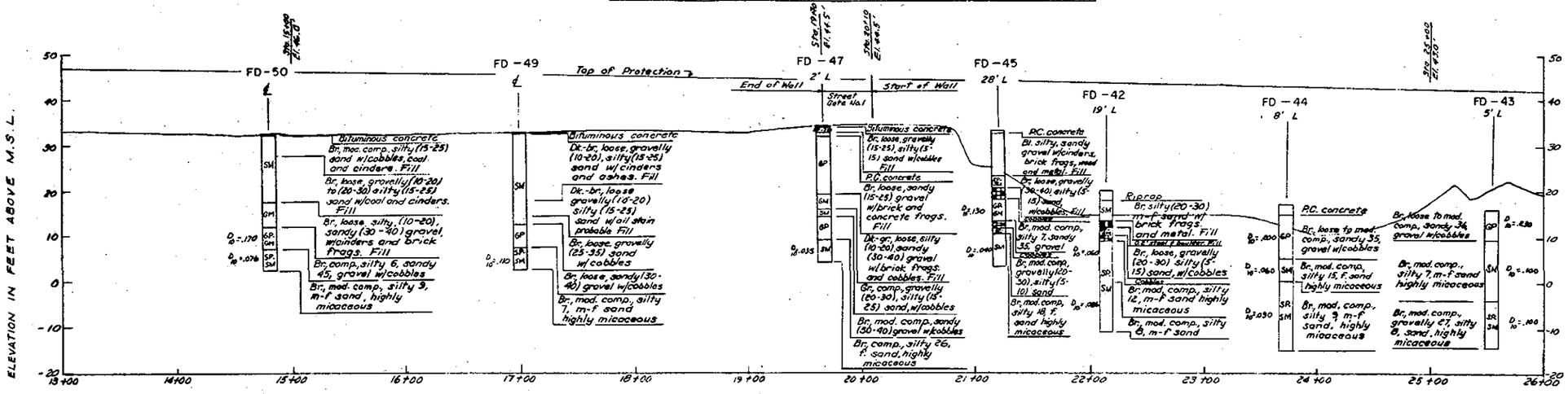
PLATE NO. 6-21

CORPS OF ENGINEERS

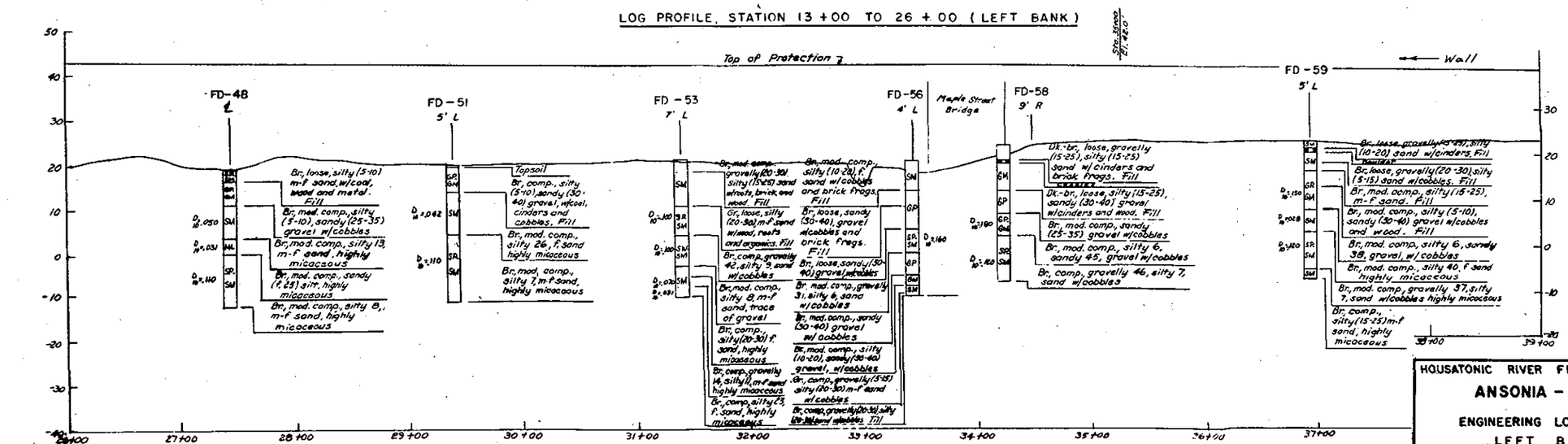
U.S. ARMY



LOG PROFILE, STATION 0 + 00 TO 13 + 00 (LEFT BANK)



LOG PROFILE, STATION 13 + 00 TO 26 + 00 (LEFT BANK)



LOG PROFILE, STATION 26 + 00 TO 39 + 00 (LEFT BANK)

HOUSATONIC RIVER FLOOD CONTROL

ANSONIA - DERBY

ENGINEERING LOG PROFILE

LEFT BANK

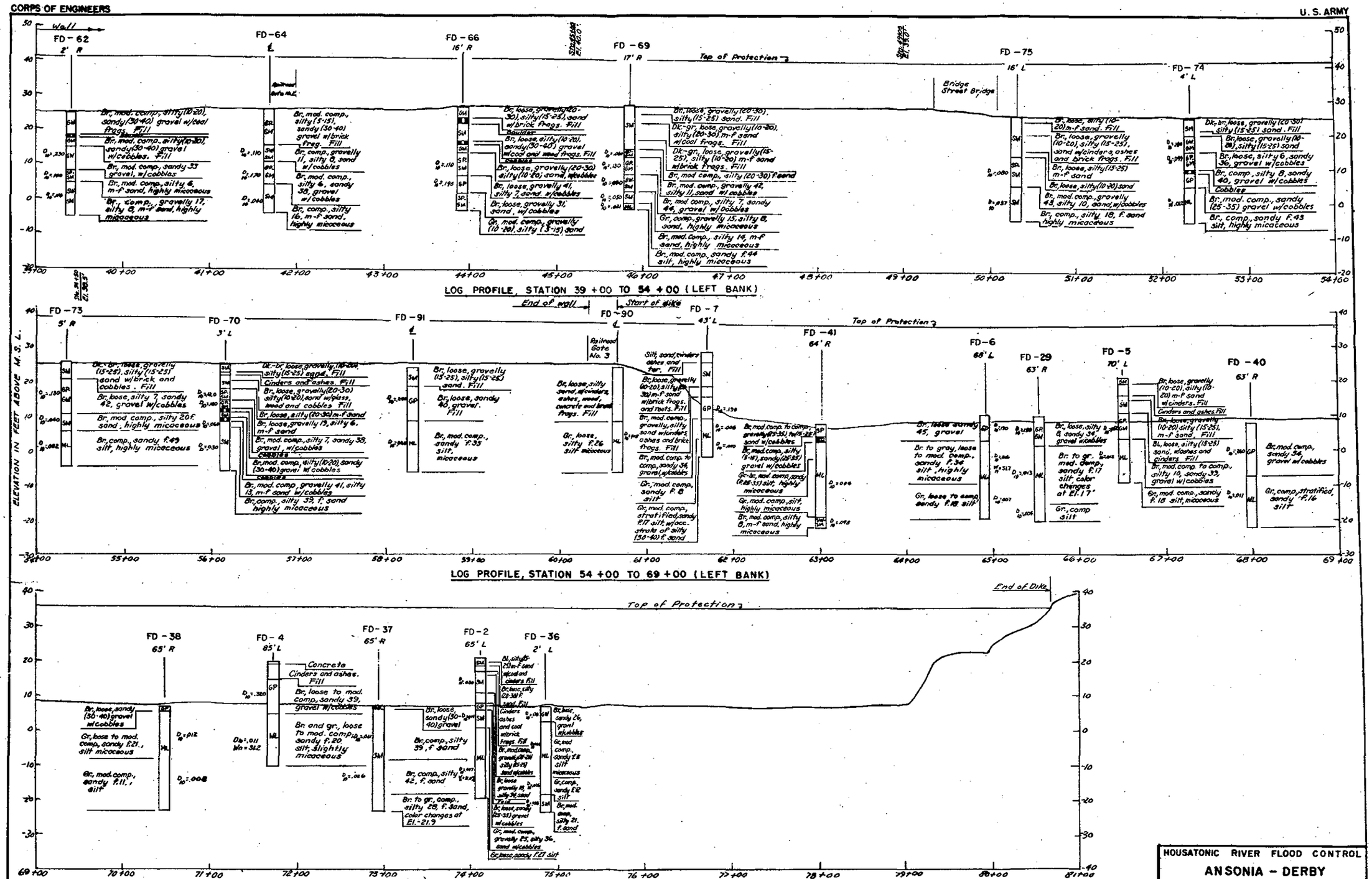
STATION 0 +00 TO 39 +00

NAUGATUCK RIVER CONNECTICUT

PLATE NO. 6-22

CORPS OF ENGINEERS

U. S. ARMY



LOG PROFILE, STATION 39 +00 TO 54 +00 (LEFT BANK)

LOG PROFILE, STATION 54 +00 TO 69 +00 (LEFT BANK)

LOG PROFILE, STATION 69 +00 TO 81 +00 (LEFT BANK)

HOUSATONIC RIVER FLOOD CONTROL

ANSONIA – DERBY

ENGINEERING LOG PROFILE

LEFT BANK

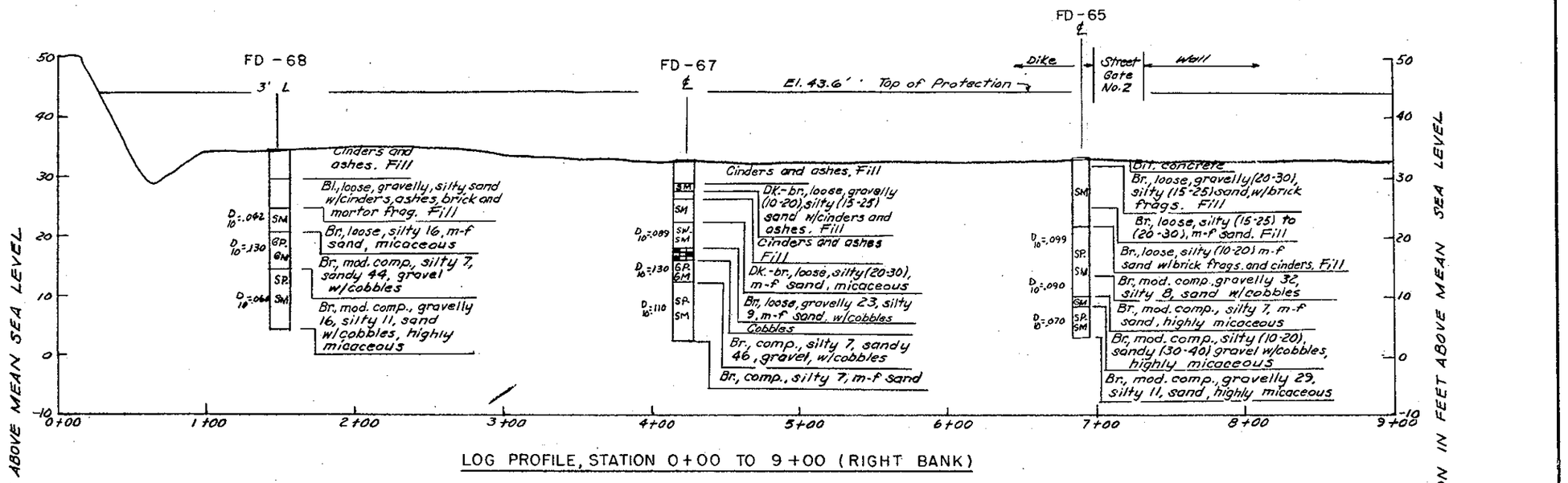
STATION 39 +00 TO 81 +00

NAUGATUCK RIVER CONNECTICUT

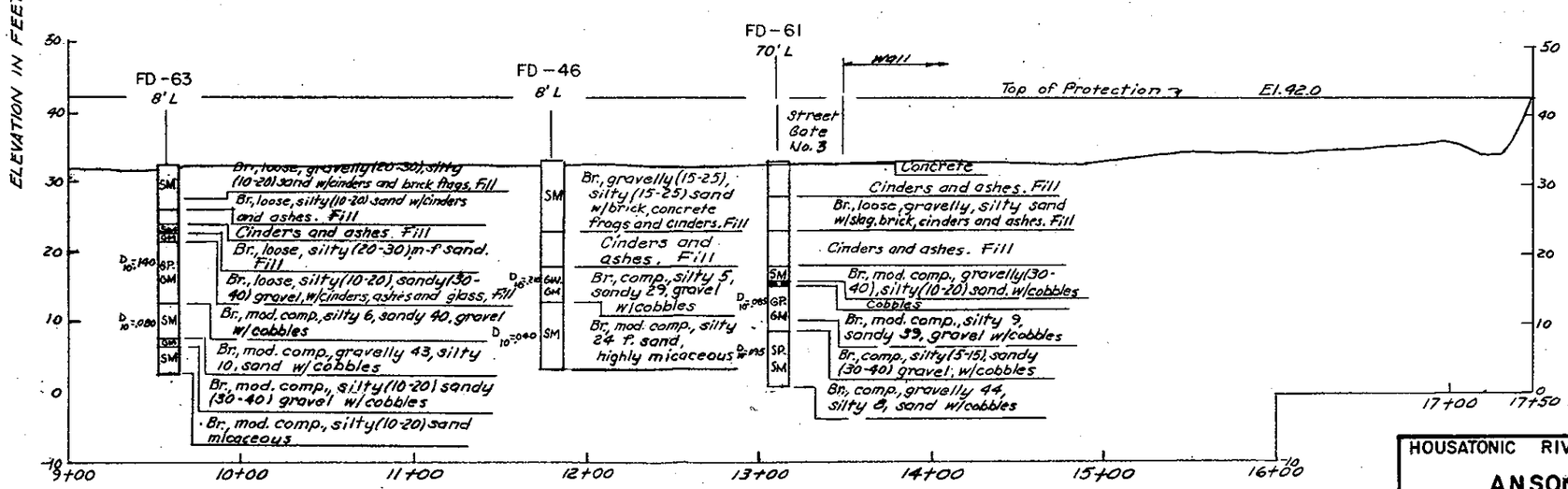
PLATE NO. 6-23

CORPS OF ENGINEERS

U.S. ARMY



LOG PROFILE, STATION 0+00 TO 9+00 (RIGHT BANK)



LOG PROFILE, STATION 9+00 TO 17+50 (RIGHT BANK)

HOUSATONIC RIVER FLOOD CONTROL

ANSONIA - DERBY

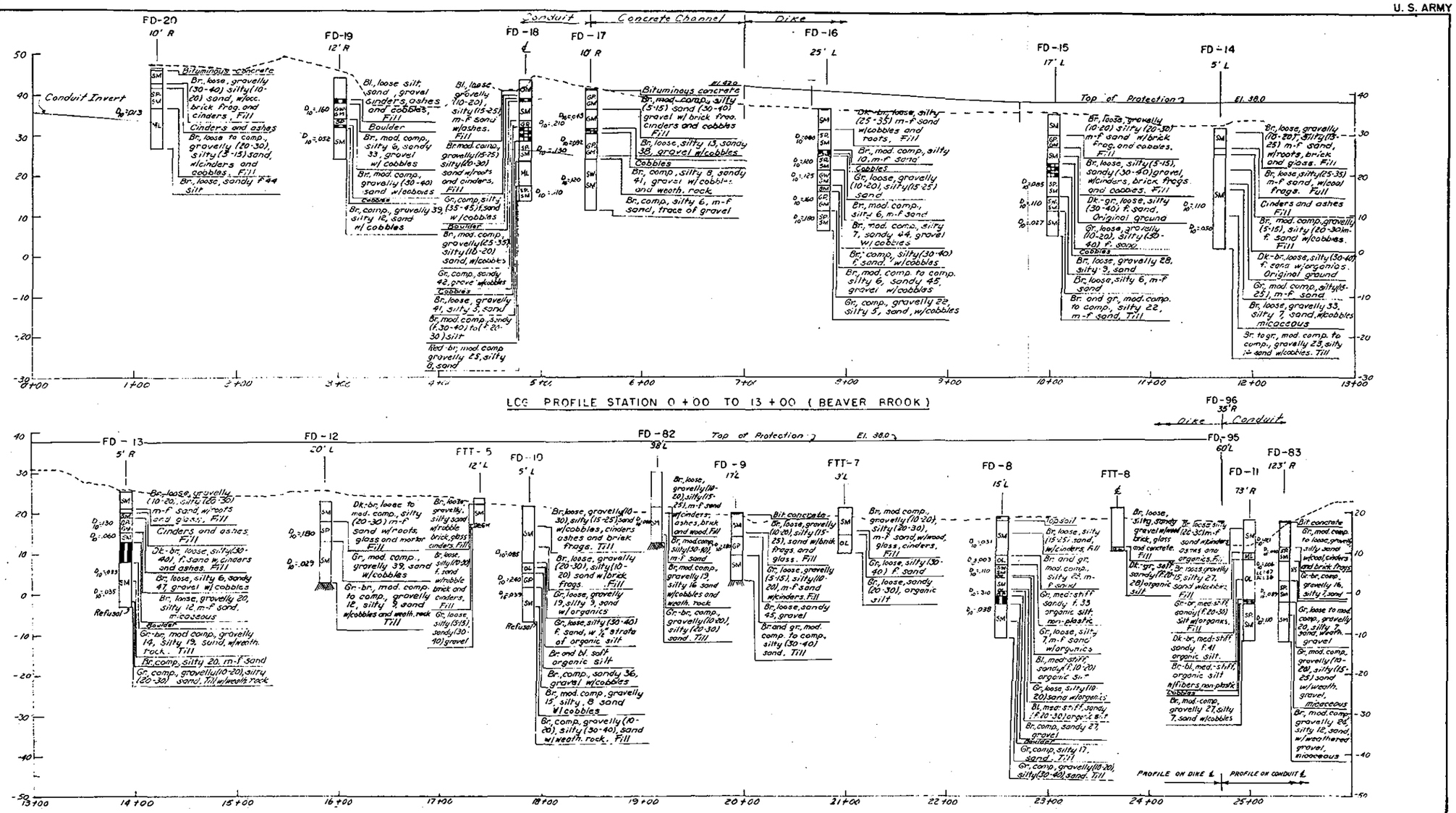
ENGINEERING LOG PROFILE
RIGHT BANK
ANSONIA MANUFACTURING CO.
STATION 0+00 TO 17+50

NAUGATUCK RIVER CONNECTICUT

PLATE NO. 6-24

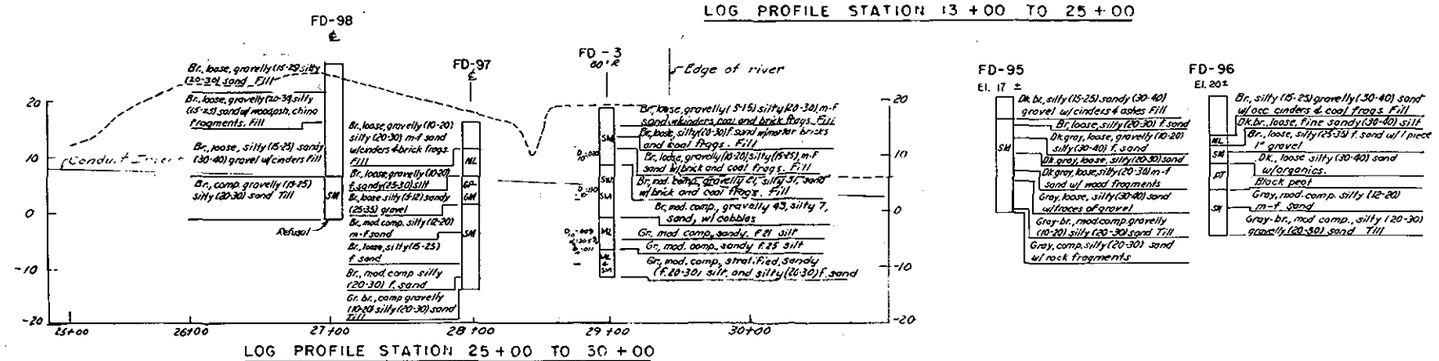
CORPS OF ENGINEERS

U. S. ARMY



LOG PROFILE STATION 0 + 00 TO 13 + 00 (BEAVER BROOK)

LOG PROFILE STATION 13 + 00 TO 25 + 00



LOG PROFILE STATION 25 + 00 TO 30 + 00

HOUSATONIC RIVER FLOOD CONTROL

ANSONIA - DERBY

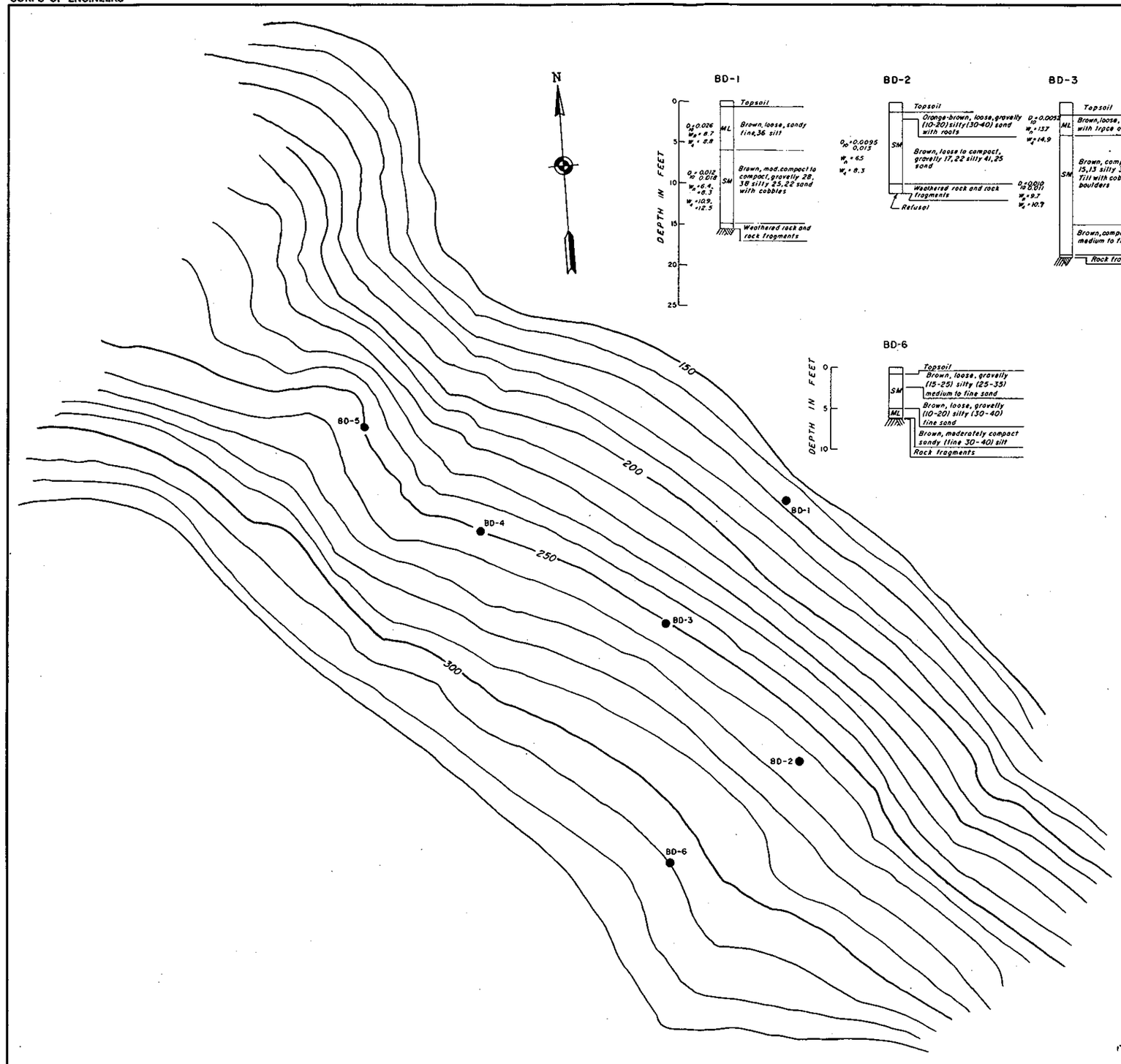
ENGINEERING LOG PROFILE

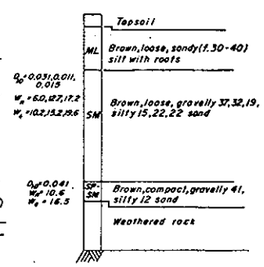
BEAVER BROOK

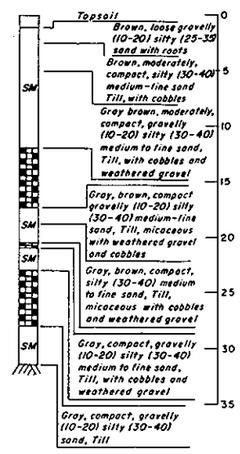
STATION 0 + 00 TO 30 + 00

NAUGATUCK RIVER CONNECTICUT

PLATE NO. 6-25







GRAPHIC SCALE
1"=100' 100' 0 100' 200'

NOTES

1. For general location of Borrow Area, see Plate No. 6-1.
2. Topography enlarged from U.S.G.S. Quad Sheet.
3. For Legend for Engineering Logs, see Plate No. 6-20

HOUSATONIC RIVER FLOOD CONTROL

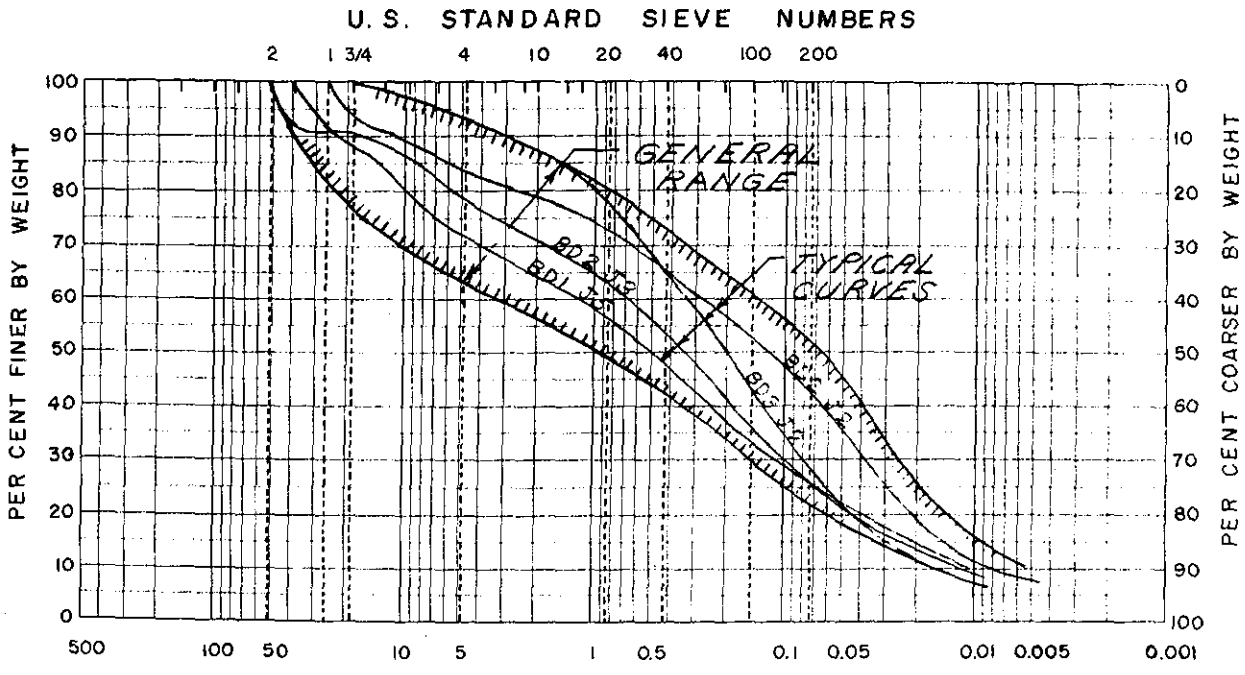
ANSONIA – DERBY

PLAN AND ENGINEERING LOGS OF BORROW EXPLORATIONS

NAUGATUCK RIVER CONNECTICUT

PLATE NO. 6-26

CORPS OF ENGINEERS U.S. ARMY



GRADATION RANGE

HOUSATONIC RIVER FLOOD CONTROL

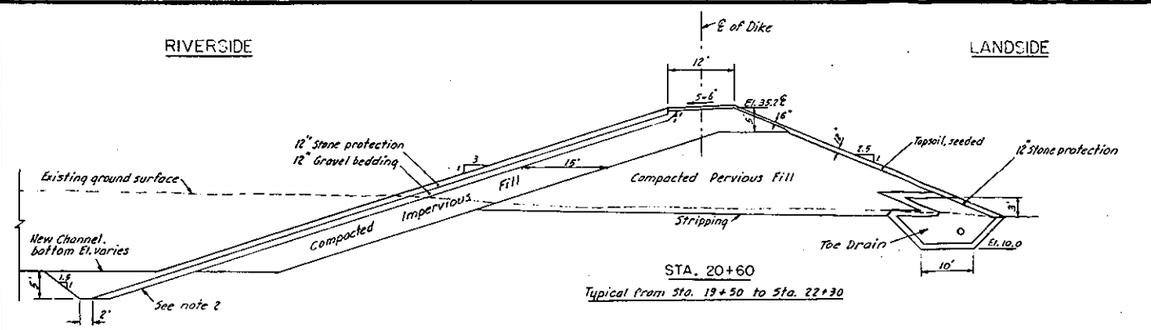
ANSONIA - DERBY

SELECTED TEST DATA
IMPERVIOUS EMBANKMENT MATERIAL

NAUGATUCK RIVER CONNECTICUT

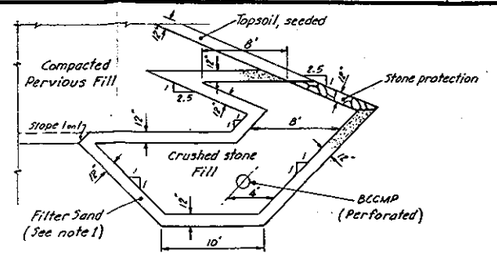
PLATE NO. 6-27

CORPS OF ENGINEERS — U. S. ARMY



STA. 20+60

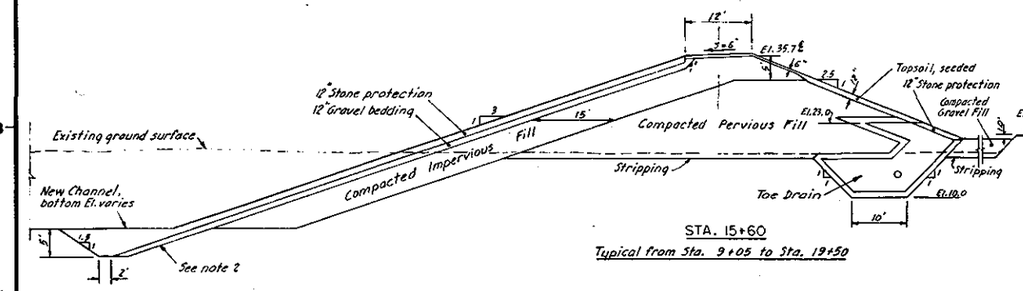
Typical from Sta. 19+50 to Sta. 22+30



TYPICAL TOE DRAIN DETAIL — RIGHT BANK

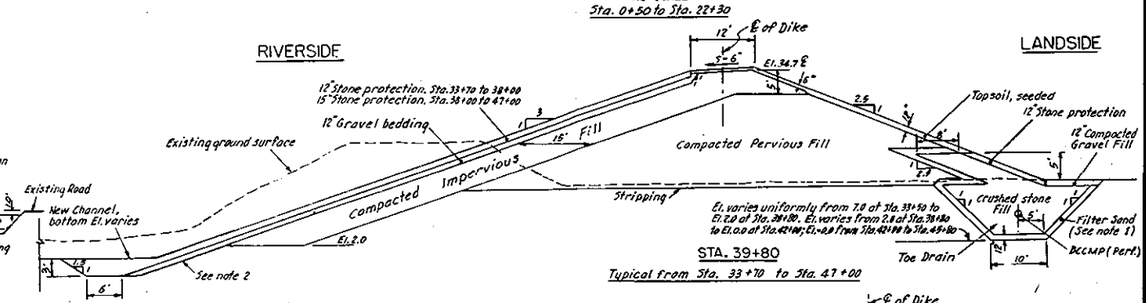
NO SCALE

Sta. 0+50 to Sta. 22+30



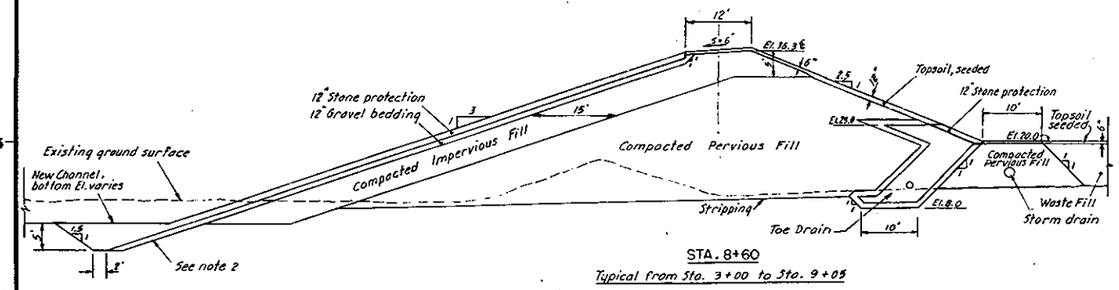
STA. 15+60

Typical from Sta. 9+05 to Sta. 19+50



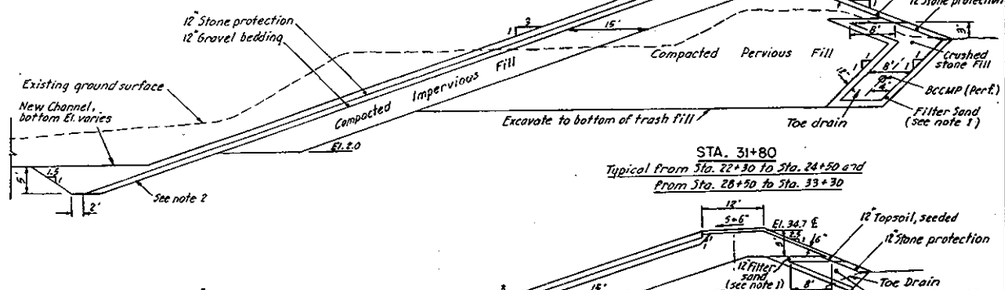
STA. 39+80

Typical from Sta. 33+70 to Sta. 47+00



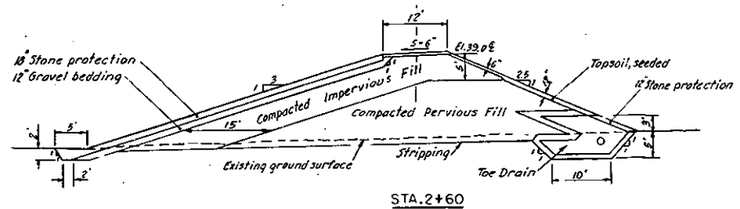
STA. 8+60

Typical from Sta. 3+00 to Sta. 9+05



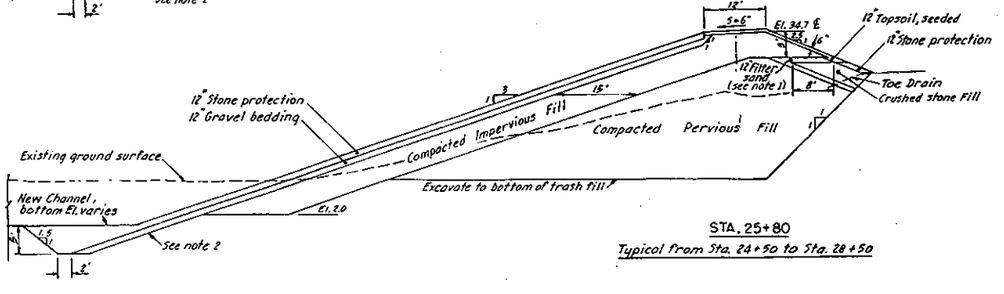
STA. 31+80

Typical from Sta. 22+30 to Sta. 24+50 and From Sta. 28+50 to Sta. 33+30



STA. 2+60

Typical from Sta. 0+50 to Sta. 3+00



STA. 25+80

Typical from Sta. 24+50 to Sta. 28+50

TYPICAL SECTIONS

SCALE 1" = 10'

NOTES

1. Omit 12" filter sand layer where base, pervious or random fill materials contain at least 20 percent gravel sizes. Where filter sand is omitted, compacted crushed stone fill shall be constructed in lieu of filter sand.
2. Omit Gravel bedding material where natural base material contains at least 40 percent Gravel sizes.

GRAPHIC SCALE

1" = 10' 20' 0 10' 20'

HOUSATONIC RIVER FLOOD CONTROL

ANSONIA - DERBY

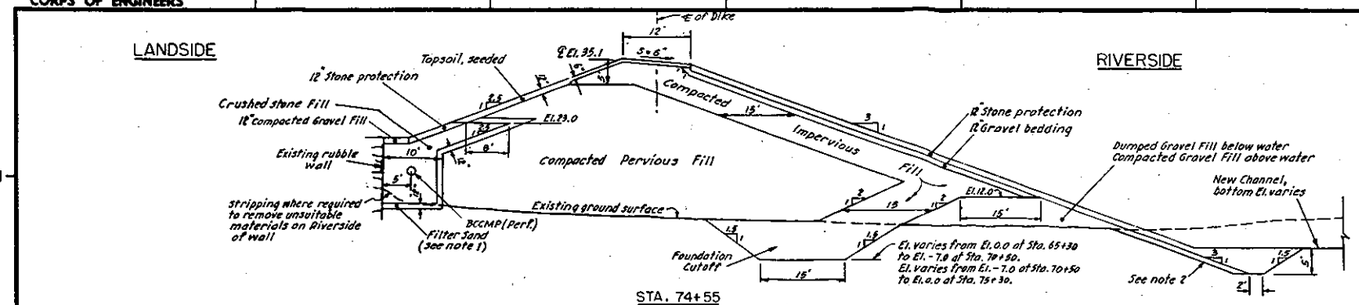
TYPICAL DIKE SECTIONS

RIGHT BANK

NAUGATUCK RIVER — CONNECTICUT

PLATE NO. 6-28

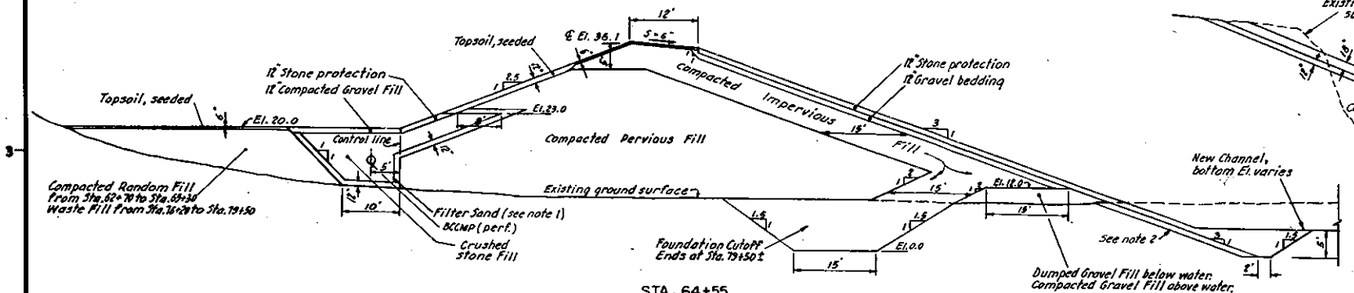
CORPS OF ENGINEERS — U. S. ARMY



STA. 74+55

Typical from Sta. 65+30 to Sta. 76+20

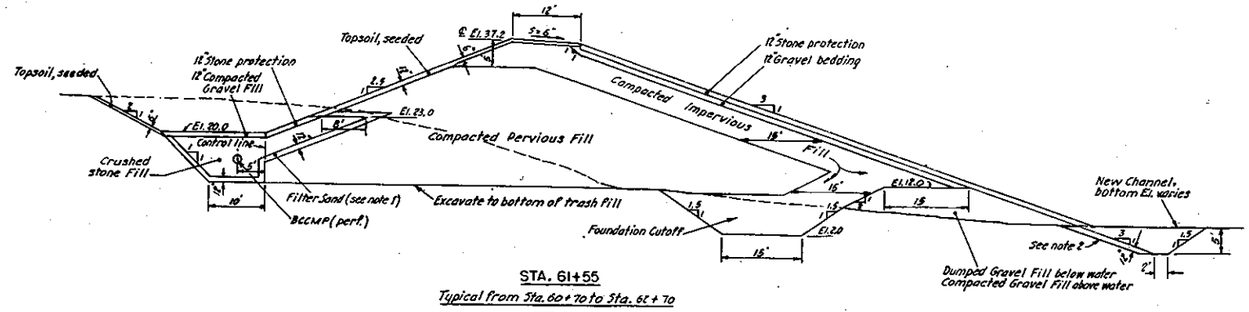
LEFT BANK



STA. 64+55

Typical from Sta. 62+70 to Sta. 65+30 and from Sta. 76+20 to Sta. 79+50

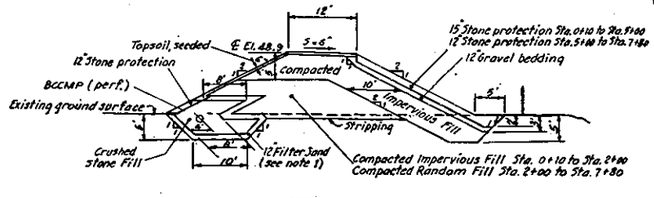
LEFT BANK



STA. 61+55

Typical from Sta. 60+70 to Sta. 62+70

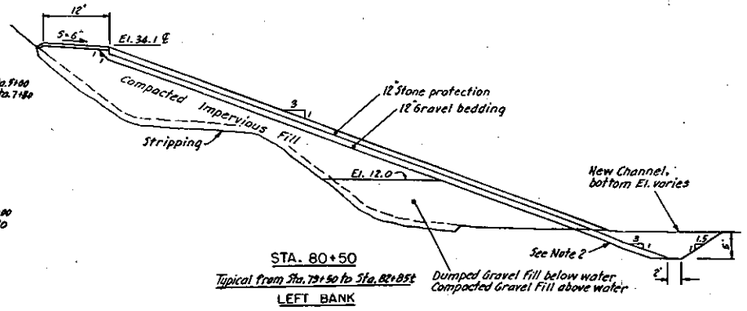
LEFT BANK



STA. 5+65

Typical from Sta. 0+10 to Sta. 7+80

LEFT BANK



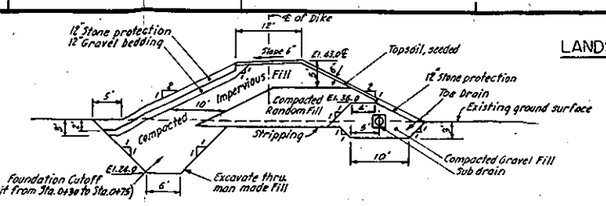
STA. 80+50

Typical from Sta. 79+50 to Sta. 82+85±

LEFT BANK

TYPICAL SECTIONS

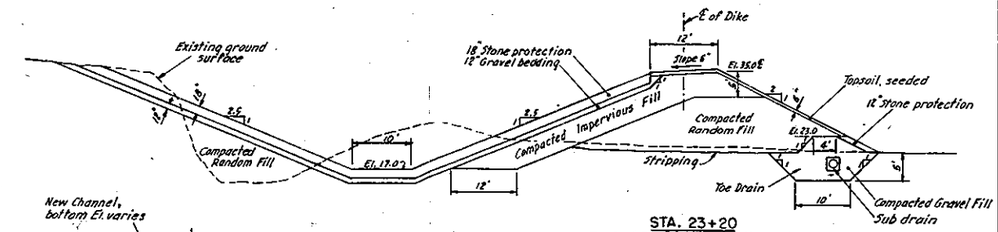
SCALE 1"=10'



STA. 5+50

Typical from Sta. 0+30 to Sta. 6+95

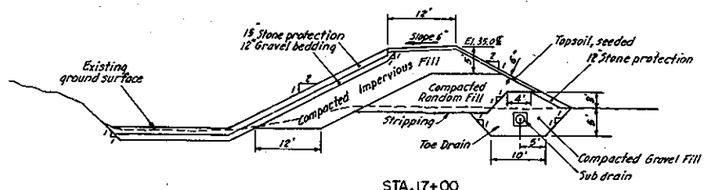
ANSONIA MANUFACTURING AREA



STA. 23+20

Typical from Sta. 17+50 to Sta. 24+25

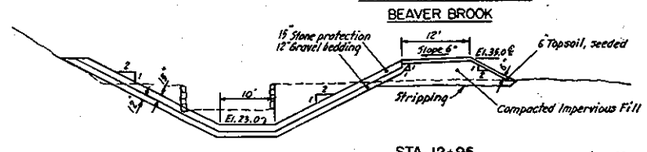
BEAVER BROOK



STA. 17+00

Typical from Sta. 13+35 to Sta. 15+40 and from Sta. 17+25 to Sta. 17+50

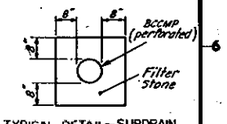
BEAVER BROOK



STA. 12+95

Typical from Sta. 7+00 to Sta. 13+35

BEAVER BROOK



TYPICAL DETAIL - SUBDRAIN

NO SCALE

NOTES

For notes 1 and 2, see Plate 6-28

GRAPHIC SCALE

1"=10' 10' 0 10' 20'

HOUSATONIC RIVER FLOOD CONTROL

ANSONIA - DERBY

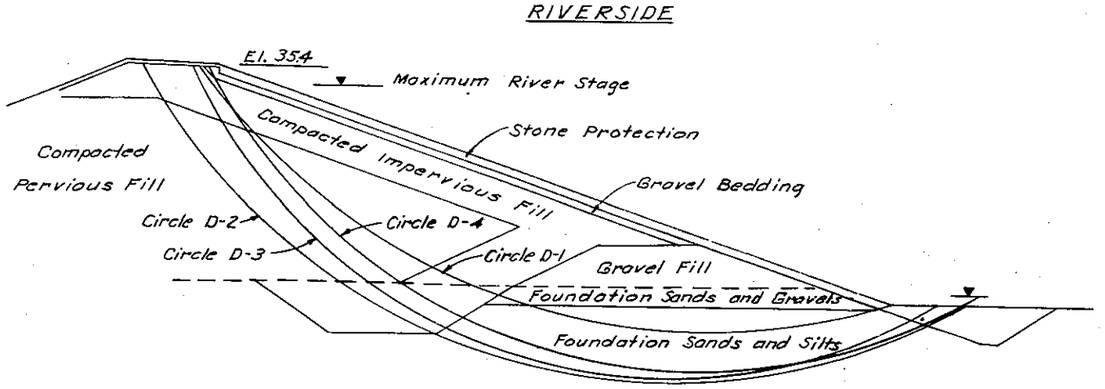
TYPICAL DIKE SECTIONS

LEFT BANK - BEAVER BROOK AND ANSONIA MANUFACTURING CO.

NAUGATUCK RIVER — CONNECTICUT

PLATE NO. 6-29

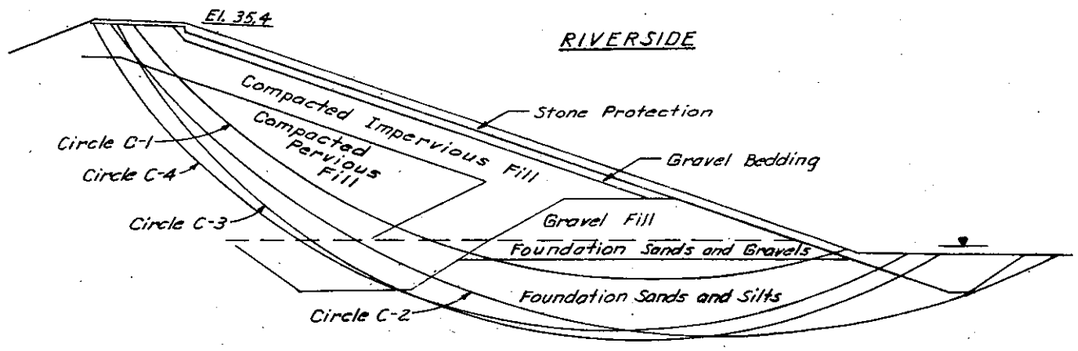
DESIGN VALUES					
Material	Unit Weight (γ) PCF				Assumed Shear Strength (All Drainage Conditions)
	γsat	γmoist	γdry	γsub	
Stone Protection	140		120	78	ϕ = 35° C=0
Gravel Bedding	145	140	130	83	ϕ = 30° C=0
Compacted Impervious Fill	140	130	120	78	ϕ = 30° C= 400 PSF
Compacted Pervious Fill and gravel Fill	145	140	130	83	ϕ = 30° C = 0
Foundation Sands and gravels	145	140	130	83	ϕ = 30° C = 0
Foundation Sands and Silts	120	100	90	58	ϕ = 25° C = 0



STATION 71+55

DRAWDOWN FROM MAXIMUM RIVER STAGE

SUMMARY OF STABILITY ANALYSES	
Sudden Drawdown Analyses	
Circle	F.S.
D-1	1.26
D-2	1.21
D-3	1.20
D-4	1.14
Construction Condition Analyses	
Circle	F.S.
C-1	1.82
C-2	1.60
C-3	1.61
C-4	1.68



STATION 71+55

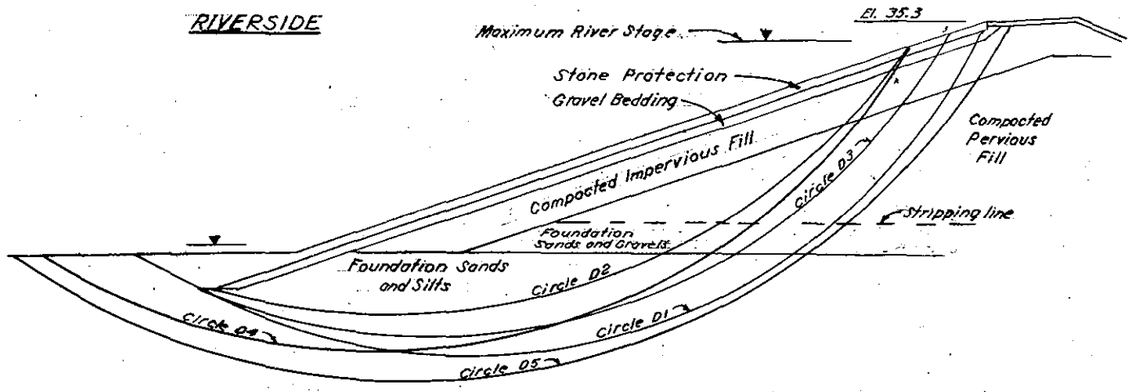
CONSTRUCTION CONDITION

GRAPHIC SCALES
10 0 10 20
1"=10'

HOUSATONIC RIVER FLOOD CONTROL
ANSONIA-DERBY
SUMMARY OF STABILITY ANALYSES
LEFT BANK
NAUGATUCK RIVER CONNECTICUT

PLATE NO. 6-30

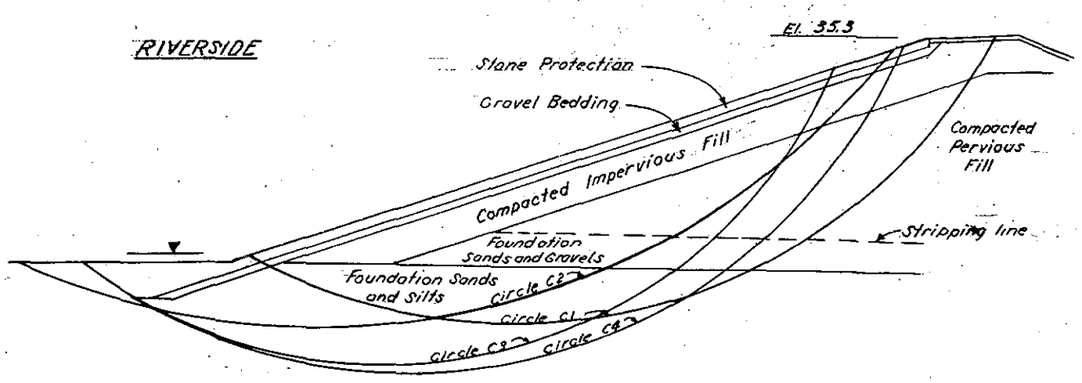
DESIGN VALUES					
Material	Unit Weight (γ) PCF				Assumed Shear Strength (All Drainage Conditions)
	γsat	γmoist	γdry	γsub	
Stone Protection	140		120	78	$\phi = 35°$ C = 0
Gravel Bedding	145	140	130	83	$\phi = 30°$ C = 0
Compacted Impervious Fill	140	130	120	78	$\phi = 30°$ C = 400 PSF
Compacted Pervious Fill and gravel Fill	145	140	130	83	$\phi = 30°$ C = 0
Foundation Sands and gravels	145	140	130	83	$\phi = 30°$ C = 0
Foundation Sands and Silts	120	100	90	58	$\phi = 25°$ C = 0



STATION 19+60

DRAWDOWN FROM MAXIMUM RIVER STAGE

SUMMARY OF STABILITY ANALYSES	
Sudden Drawdown Analyses	
Circle	F.S.
D-1	1.03
D-2	1.13
D-3	1.08
D-4	1.06
D-5	1.04
Construction Condition Analyses	
Circle	F.S.
C-1	1.58
C-2	1.57
C-3	1.42
C-4	1.48



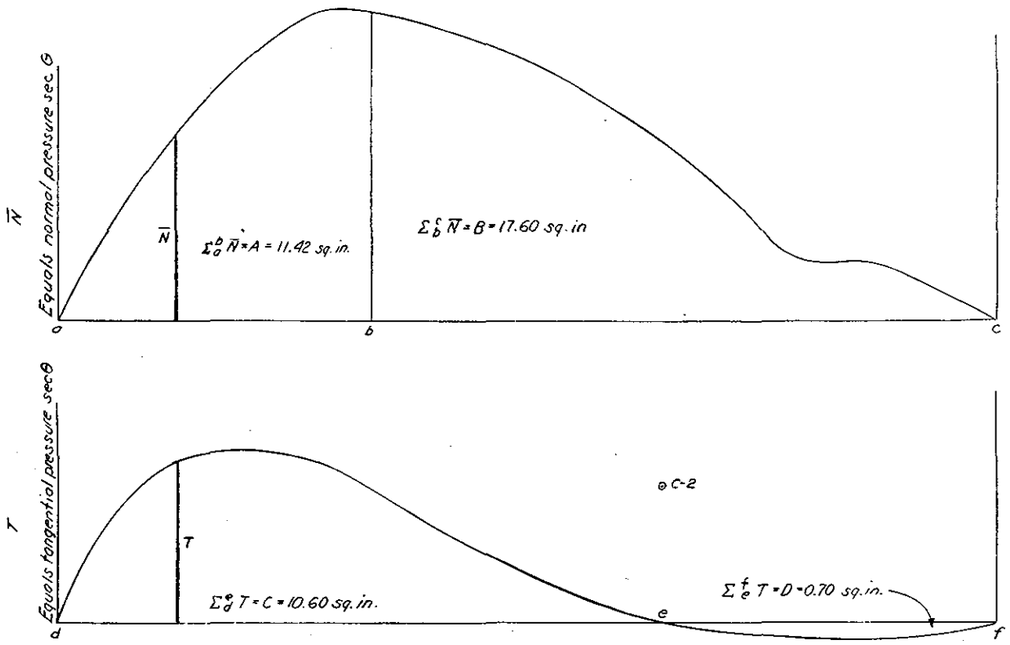
STATION 19+60

CONSTRUCTION CONDITION

GRAPHIC SCALE
10 0 10 20
1"=10'

HOUSATONIC RIVER FLOOD CONTROL
ANSONIA-DERBY
SUMMARY OF STABILITY ANALYSES
RIGHT BANK
NAUGATUCK RIVER CONNECTICUT

PLATE NO. 6-31



RESISTING FORCE = Summation $\bar{N}$ tan ϕ $c\Delta$

(k = vector scale conversion factor
$= 10 \frac{ft.}{in.} \times 10 \frac{ft.}{in.} \times 62.4 \frac{lbs.}{sq\,ft} \times \frac{1\,kip}{1000\,lbs} = 6.24$ kips/sq. in)

$\int_a^c \bar{N}$ tan $\phi = \Delta$ A tan 30° + B tan 25°] k

$= [11.42 \times 0.577 + 17.60 \times 0.466]\ 6.24 = 92.5^k$

$c\Delta = c(L_1 + L_2) = 0.4 \times 17.5 = 7.0^k$

TOTAL RESISTING FORCE / 1 ft dike = 99.5^k

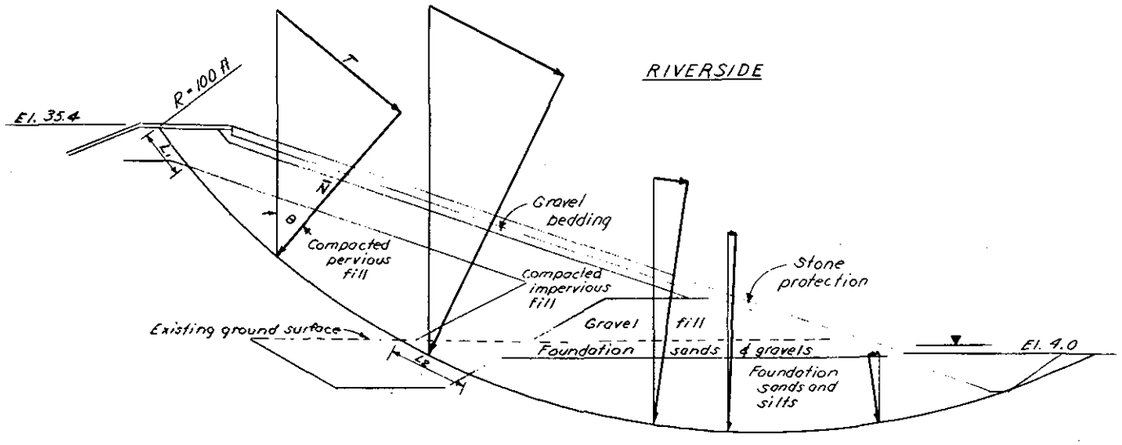
DRIVING FORCE = Summation tangential forces

$\int_d^f T = (C - D)k = (10.60 - 0.70)\ 6.24 = 62.0^k$

FACTOR OF SAFETY = $\frac{\text{RESISTING FORCE}}{\text{DRIVING FORCE}} = \frac{99.5}{62.0} = 1.60$

WEIGHT VECTOR RATIOS
62.4 lbs. = 1.00

MATERIAL		VECTOR		RATIO		(V_R)
Stone protection	(dry)	120	÷	62.4	=	1.92
Gravel bedding	(moist)	140	÷	62.4	=	2.24
Compacted impervious fill	(moist)	130	÷	62.4	=	2.08
Compacted impervious fill	(sub)	78	÷	62.4	=	1.25
Compacted pervious and gravel fill	(moist)	140	÷	62.4	=	2.24
Compacted pervious and gravel fill	(sub)	83	÷	62.4	=	1.33
Foundation sands and gravels	(moist)	140	÷	62.4	=	2.24
Foundation sands and gravels	(sub)	83	÷	62.4	=	1.33
Foundation sands and silts	(sub)	58	÷	62.4	=	0.93



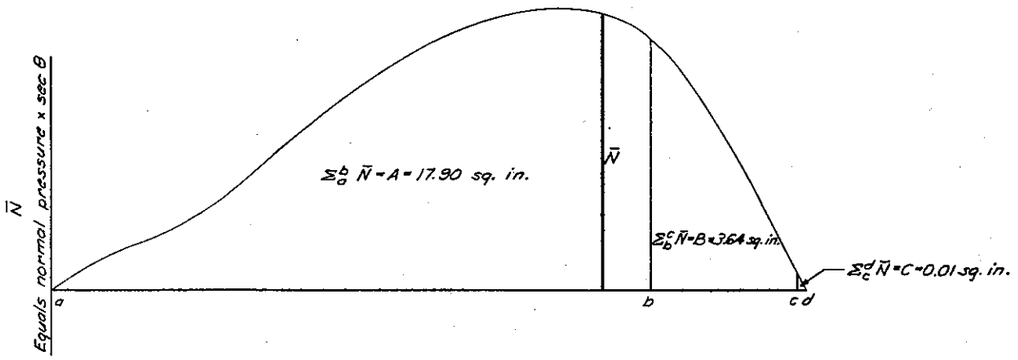
STATION 71+55

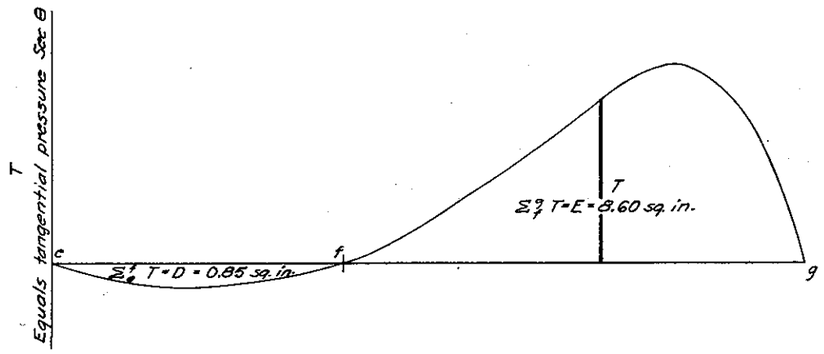
TYPICAL VECTOR DIAGRAM

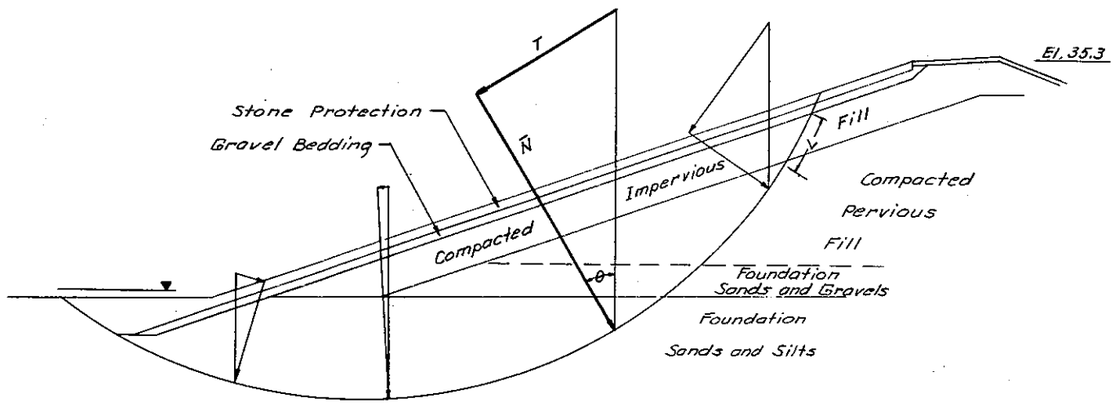
SPACE SCALE
10' 0 10' 20' FT.
62.4 0 62.4 124.8 LBS.
VECTOR SCALE

HOUSATONIC RIVER FLOOD CONTROL
ANSONIA-DERBY
TYPICAL STABILITY ANALYSIS
CONSTRUCTION CONDITION CIRCLE C-2
LEFT BANK
NAUGATUCK RIVER CONNECTICUT

PLATE NO. 6-32







STATION 19 + 60

RESISTING FORCE = Summation $\bar{N}$ tan ϕ + $c\bar{L}$

(K = Vector scale conversion factor
= 10 FT./IN. × 10 FT./IN. × 62.4 LBS./SQ. FT. × 1 Kip/1000 LBS = 6.24 kips/SQ. IN.)

$\int_a^d \bar{N} \tan \phi = [A \tan 25° + B \tan 30° + C \tan 35°] K$

$= [17.90 \times 0.466 + 3.64 \times 0.577 + 0.01 \times 0.7] 6.24 = 65.2K$

$c\bar{L} = 0.4 \times 8 = 3.2K$

Total Resisting Force/Ft. Dike 68.4K

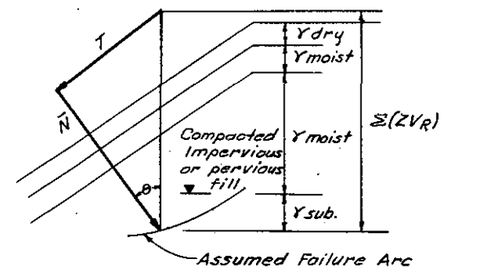
DRIVING FORCE = Summation Tangential Forces

$\int_c^g T = (E-D) K = (8.60 - 0.85) 6.24 = 48.3K$

Factor of Safety = Resisting Force / Driving Force = 68.4 K / 48.3 K = 1.42

WEIGHT VECTOR RATIOS
62.4 lbs. = 1.00

Material		Vector Ratio (V_R)
Slope Protection	(dry)	120 ÷ 62.4 = 1.92
Gravel Bedding	(moist)	140 ÷ 62.4 = 2.24
Compacted Impervious Fill	(moist)	130 ÷ 62.4 = 2.08
Compacted Impervious Fill	(sub)	78 ÷ 62.4 = 1.25
Compacted Pervious and Gravel Fill	(moist)	140 ÷ 62.4 = 2.24
Compacted Pervious and Gravel Fill	(sub)	83 ÷ 62.4 = 1.33
Foundation Sands and Gravels	(moist)	140 ÷ 62.4 = 2.24
Foundation Sands and Gravels	(sub)	83 ÷ 62.4 = 1.33
Foundation Sands and Silts .	(sub)	58 ÷ 62.4 = 0.93



Z = Vertical distance
V = Unit weight of soil
V_R = Vector Ratio

TYPICAL VECTOR DIAGRAM

SPACE SCALE

10 0 10 20 FT.

62.4 0 62.4 124.8 LBS.

VECTOR SCALE

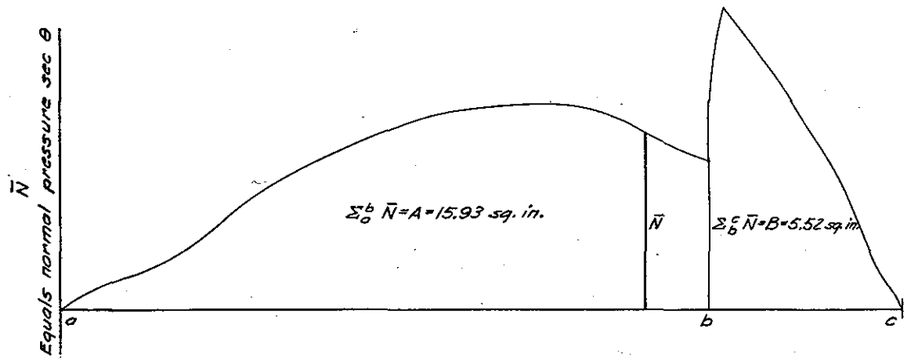
HOUSATONIC RIVER FLOOD CONTROL

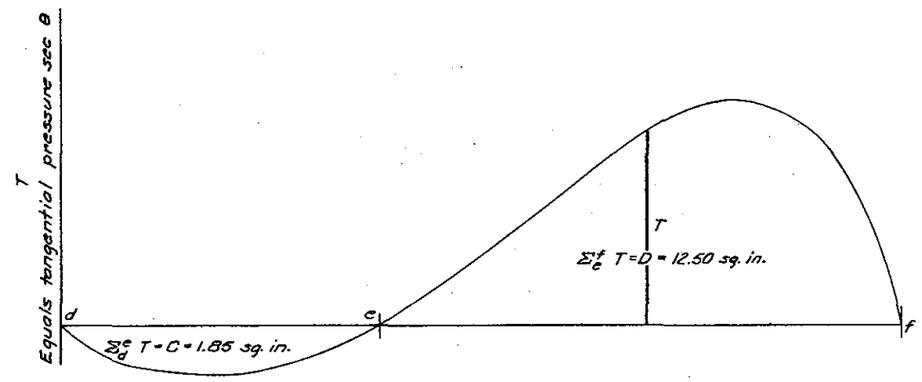
ANSONIA - DERBY

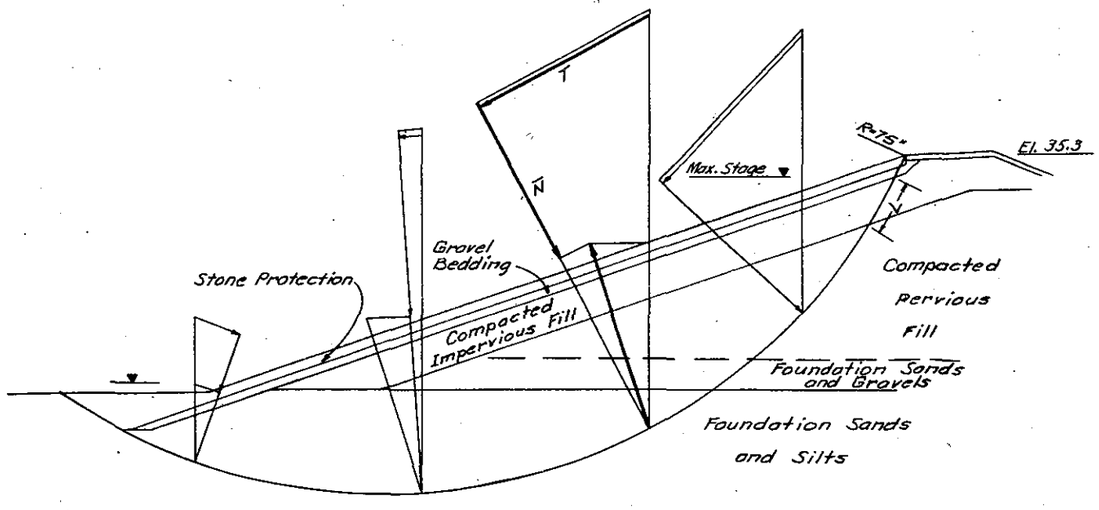
TYPICAL STABILITY ANALYSIS
CONSTRUCTION CONDITION CIRCLE C-3
RIGHT BANK

NAUGATUCK RIVER CONNECTICUT

PLATE NO. 6-34







STATION 19+60

RESISTING FORCE = Summation $\bar{N} \tan \phi + c\bar{L}$

$\left(K = \text{Vector scale conversion factor} = 10 \frac{FT.}{IN.} \times 10 \frac{FT.}{IN.} \times 62.4 \frac{LBS.}{SQ.FT.} \times \frac{1 KIP}{1000 LBS.} = 6.24 \frac{KIPS}{SQ.IN.}\right)$

$\int_a^c \bar{N} \tan \phi = [A \tan 25° + B \tan 30°] K$

$= [15.93 \times 0.466 + 5.52 \times 0.577] 6.24 = 66.1 K$

$C\bar{L} = 0.4 \times 7 = \underline{2.8 K}$

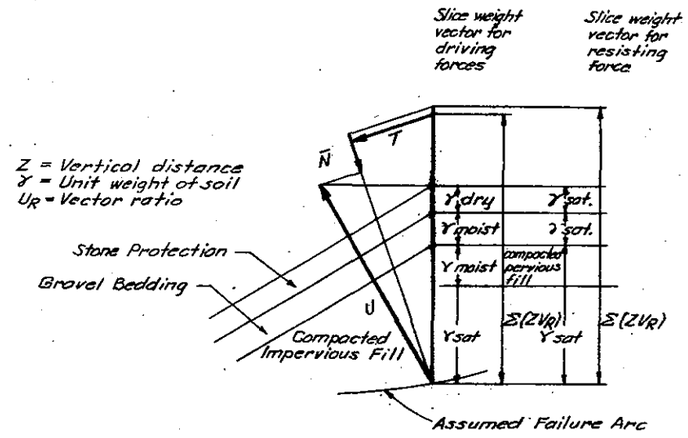
Total Resisting Force / Ft. Dike = 68.9 K

DRIVING FORCE = Summation Tangential Forces

$\int_d^f T = (D - C) K = (12.50 - 1.85) 6.24 = 66.4 K$

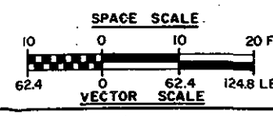
Factor of Safety = $\frac{\text{Resisting Force}}{\text{Driving Force}} = \frac{68.9 K}{66.4 K} = \underline{1.03}$

WEIGHT VECTOR RATIOS 62.4 lbs. = 1.00		
Material		Vector Ratio (V_R)
Stone Protection	(sat.)	140 ÷ 62.4 = 2.24
Stone Protection	(dry)	120 ÷ 62.4 = 1.92
Gravel Bedding	(sat.)	145 ÷ 62.4 = 2.32
Gravel Bedding and Pervious Fill	(moist)	140 ÷ 62.4 = 2.24
Compacted Impervious Fill	(sat.)	140 ÷ 62.4 = 2.24
Compacted Pervious Fill	(sat.)	145 ÷ 62.4 = 2.32
Gravel Fill	(sat.)	145 ÷ 62.4 = 2.32
Foundation Sands and Gravels	(sat.)	145 ÷ 62.4 = 2.32
Foundation Sands and Silts	(sat.)	120 ÷ 62.4 = 1.92



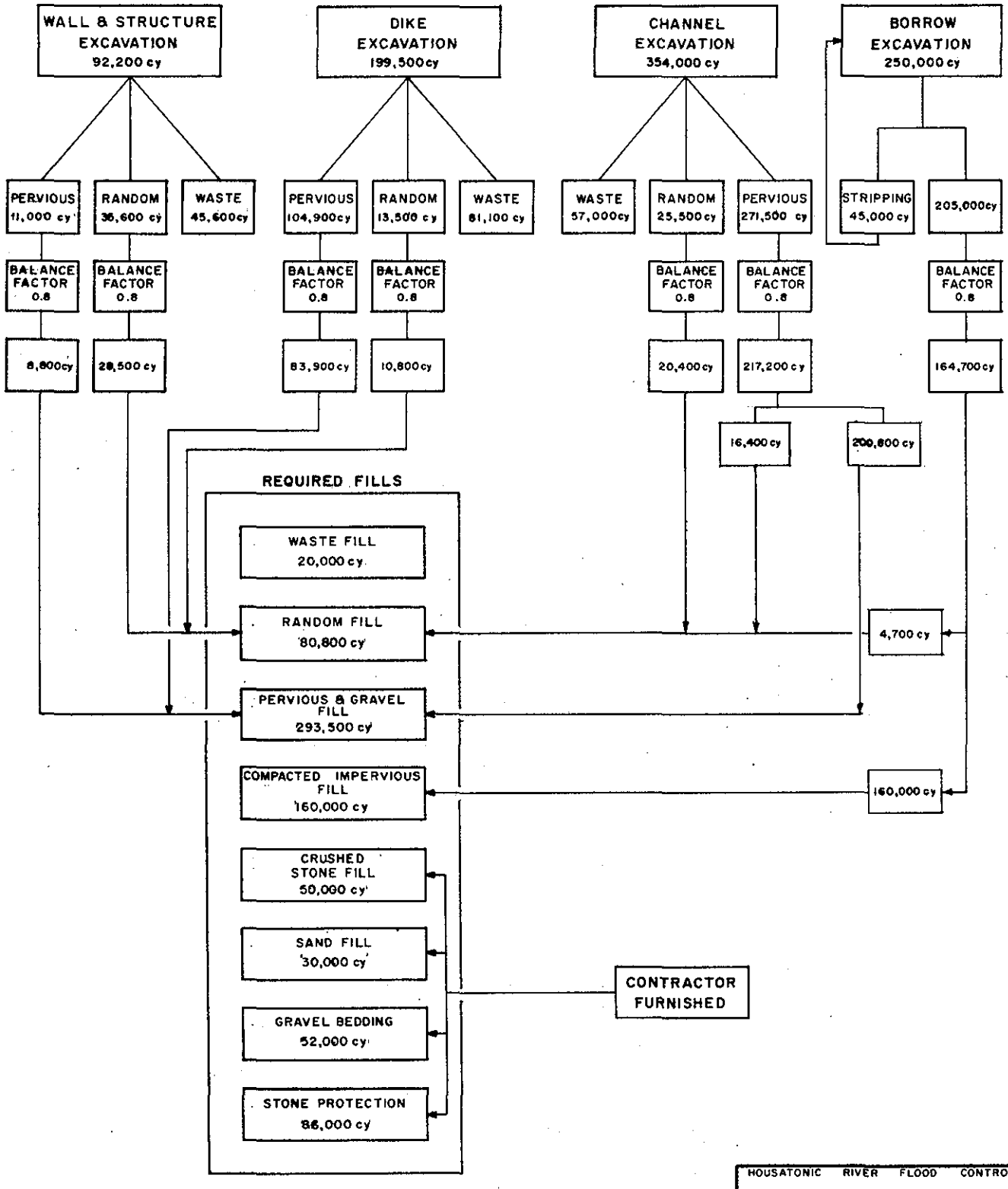
NOTE:
U Force assumed zero in zone of pervious fill.

TYPICAL VECTOR DIAGRAM



HOUSATONIC RIVER FLOOD CONTROL
ANSONIA-DERBY
TYPICAL STABILITY ANALYSES
DRAWDOWN CONDITION — CIRCLE D-1
RIGHT BANK
NAUGATUCK RIVER CONNECTICUT

PLATE NO. 6-35



HOUSATONIC RIVER FLOOD CONTROL

ANSONIA-DERBY

MATERIALS USAGE CHART
PRELIMINARY

NAUGATUCK RIVER CONNECTICUT

PLATE NO. 6-36

APPENDIX A

SUMMARY OF LABORATORY TEST RESULTS

ANSONIA-DERBY LOCAL PROTECTION

SOIL TESTS RESULTS

EXPL. NO.	TOP ELEV. FT.	SAMPLE NO.	DEPTH FT.	SOIL SYMBOL	MECHANICAL ANALYSIS				ATT. LIMITS		SPECIFIC GRAVITY	NAT. WATER CONTENT % DRY WT		COMPACTION DATA			NAT. DRY DENSITY LBS/CU FT		OTHER TESTS			Organic Content %
					GRAVEL %	SAND %	FINES %	D_{10} mm.	LL	PL		TOTAL	- NO4	STND. AASHO OPT. WATER % DRY WT	STND. AASHO MAX. DRY DENS. LBS/CU FT	* PVD LBS/CU FT	TOTAL	- NO4	SHEAR	CONSOL.	PERM.	
FD-1	20.2	J-4	7.3-10.0	SP-SM	0	91	9	.080														
		J-7	13.8-15.0	OL																		14.3
		J-9	15.0-19.0	SW	0	96	4	.170														
		J-11	20.0-25.0	ML	0	39	61	.011														
		J-12R	20.0-25.0	ML								32.8										
		J-15	30.0-33.6	SP-SM	0	88	12	.069														
FD-2	20.2	J-5	5.0-10.0	SM	18	48	34	.020														
		J-7	15.0-20.0	SM	25	39	36	.011														
		J-10	25.0-30.0	ML	0	27	73	.007														
		J-11R	25.0-30.0	ML								31.0										
FD-3	19.3	J-4	7.1-10.0	SM	21	48	31	.020														
		J-5	10.0-15.0	SW-SM	43	50	7	.110														
		J-7	20.0-23.3	ML	0	21	79	.009														
		J-8R	20.0-23.3	ML								30.5										
		J-9	23.3-25.0	ML	0	25	75	.011														
FD-4	19.0	J-4	5.0-10.0	GP	55	42	3	.320														
		J-8	17.1-20.0	ML	0	19	81	.011														
		J-9	17.1-20.0	ML								31.2										
		J-12	25.0-30.0	ML	0	21	79	.011														
FD-5	20.8	J-5	10.0-15.0	GP-GM	51	38	11	.062														
		J-9	20.0-25.0	ML	0	18	82	.012														
FD-6	10.5	J-1	0.0- 5.0	GP	50	46	4	.190														
		J-5	10.0-15.0	ML	0	34	66	.016														
		J-6R	10.0-15.0	ML								31.7										
		J-9	20.0-25.0	ML	0	18	82	.007														

NED FORM JUL 63 510

* PROVIDENCE VIBRATED DENSITY TEST

ANSONIA-DERBY LOCAL PROTECTION

SOIL TESTS RESULTS

EXPL. NO.	TOP ELEV. FT.	SAMPLE NO.	DEPTH FT.	SOIL SYMBOL	MECHANICAL ANALYSIS				ATT. LIMITS		SPECIFIC GRAVITY	NAT. WATER CONTENT % DRY WT		COMPACTION DATA			NAT. DRY DENSITY LBS/CU FT		OTHER TESTS			Organic Content %
					GRAVEL %	SAND %	FINES %	D_{10} mm.	LL	PL		TOTAL	-NO4	STND. AASHO OPT. WATER % DRY WT	STND. AASHO MAX. DRY DENS. LBS/CU FT	* PVD LBS/CU FT	TOTAL	-NO4	SHEAR	CONSOL.	PERM.	
FD-7	23.6	J-6	15.0-19.2	GP	62	33	5	.190														
		J-8	20.0-25.0	ML	0	7	93	.006														
		J-10	25.0-30.0	ML	0	17	83	.010														
FD-8	20.7	J-5	5.8- 7.5	SM	0	77	23	.031														
		J-8	10.0-12.0	OL	0	33	67	.003	NP	NP												
		J-9	12.0-14.7	SW-SM	0	93	7	.110														
		J-13	18.4-19.8	GP	71	26	3	.310														
		J-14	21.8-25.0	SM	9	84	7	.038														
FD-9	21.0	J-4	6.7-10.0	GP	52	45	3	.280														
FD-10	22.4	J-3	10.0-14.3	SP-SM	19	72	9	.085														
		J-6	16.9-20.0	GW	61	35	4	.240														
		J-7	20.0-25.0	SM	15	67	18	.039														
FD-11	20.6	J-2	2.2- 5.0	SM	15	58	27	.021														
		J-6	10.0-15.0	OL	0	42	58	.004	47	36	(Atterberg Limit tests on oven-dried soil indicate material is non-plastic)											4.8
		J-8	15.0-20.0						NP	NP												
		J-10	21.0-25.0	SP-SM	27	66	7	.110														14.2
FD-12	23.6	J-2	5.0-10.0	SP	38	57	5	.180														
		J-3	10.0-15.0	SM	12	69	19	.029														
FD-13	25.4	J-4	6.3-10.0	GP-GM	47	46	7	.130														
		J-5	10.0-12.3	SM	20	68	12	.060														
		J-6	17.3-22.0	SM	14	68	18	.033														
		J-7	22.0-27.0	SM	1	80	19	.035														

NED FORM JUL 63 510

* PROVIDENCE VIBRATED DENSITY TEST

ANSONIA-DERBY LOCAL PROTECTION

SOIL TESTS RESULTS

EXPL. NO.	TOP ELEV. FT.	SAMPLE NO.	DEPTH FT.	SOIL SYMBOL	MECHANICAL ANALYSIS				ATT. LIMITS		SPECIFIC GRAVITY	NAT. WATER CONTENT % DRY WT		COMPACTION DATA			NAT. DRY DENSITY LBS/CU FT		OTHER TESTS			Organic Content %
					GRAVEL %	SAND %	FINES %	D_{10} mm.	LL	PL		TOTAL	- NO 4	STND. AASHO OPT. WATER % DRY WT	STND. AASHO MAX. DRY DENS. LBS/CU FT	* PVD LBS/CU FT	TOTAL	- NO 4	SHEAR	CONSOL.	PERM.	
FD-14	32.2	J-8	15.0-20.0	SP-SM	33	60	7	.110														
		J-10	21.6-25.0	SM	23	64	13	.050														
FD-15	35.3	J-5	15.0-20.0	SP-SM	28	64	8	.085														
		J-6	20.0-23.6	SW-SM	4	89	7	.110														
		J-8	25.0-30.0	SM	7	71	22	.027														
FD-16	36.8	J-2	5.0-10.0	SP-SM	0	91	9	.080														
		J-4	11.4-15.0	SP-SM	4	90	6	.120														
		J-5	15.0-18.9	GW-GM	49	44	7	.125														
		J-7	20.0-25.0	GP-GM	49	45	6	.160														
		J-8	25.0-30.0	SP-SM	22	73	5	.180														
FD-17	41.5	J-2	5.0- 9.9	GM	49	38	13	.043														
		J-3	11.0-15.0	GM	51	41	8	.092														
		J-6	20.0-25.0	SW-SM	8	86	6	.120														
FD-18	43.6	J-5	10.0-11.8	GP	54	42	4	.210														
		J-6	15.0-20.0	SP-SM	41	53	6	.130														
		J-10	26.2-30.0	SP-SM	24	68	8	.110														
FD-19	43.9	J-2	6.0-10.0	GW-GM	62	32	6	.160														
		J-4	12.0-15.0	SM	39	48	12	.052														
FD-20	46.8	J-6	15.0-20.0	ML	0	43	57	.013														

A-3

NED FORM JUL 63 510

* PROVIDENCE VIBRATED DENSITY TEST

ANSONIA-DERBY LOCAL PROTECTION

SOIL TESTS RESULTS

EXPL. NO.	TOP ELEV. FT.	SAMPLE NO.	DEPTH FT.	SOIL SYMBOL	MECHANICAL ANALYSIS				ATT. LIMITS		SPECIFIC GRAVITY	NAT. WATER CONTENT % DRY WT		COMPACTION DATA			NAT. DRY DENSITY LBS/CU FT		OTHER TESTS			
					GRAVEL %	SAND %	FINES %	D_{10} mm.	LL	PL		TOTAL	-NO4	STND. AASHO OPT. WATER % DRY WT	STND. AASHO MAX. DRY DENS. LBS/CU FT	* PVD LBS/CU FT	TOTAL	-NO4	SHEAR	CONSOL.	PERM.	
FD-21	16.1	J-1	0.0- 2.5	SP-SM	0	92	8	.075														
		J-6	5.0- 7.0	SP-SM	27	63	10	.069														
		J-8	10.0-12.0	GP-GM	54	40	6	.170														
		J-11	15.0-20.0	ML	0	84	16	.005														
		J-13	20.0-25.0	ML	0	63	37	.013														
FD-22	18.1	J-2	1.1- 3.3	SP	0	97	3	.092														
		J-4	5.0-10.0	GP	60	36	4	.300														
		J-6	12.5-15.0	SP-SM	39	50	11	.065														
		J-8	20.0-25.0	ML	0	19	81	.005														
FD-23	18.5	J-2	1.5- 4.0	SP	0	96	4	.110														
		J-5	10.0-15.0	GW-GM	61	32	7	.130														
FD-24	19.0	J-2	2.6- 4.0	SP-SM	3	88	9	.079														
		J-5	10.0-15.0	GW-GM	63	31	6	.050														
		J-9	20.0-25.0	SP	33	65	2	.300														
FD-25	19.9	J-3	5.0- 9.0	SP	4	92	4	.120														
		J-5	10.0-15.0	GP-GM	58	36	6	.150														
		J-7	15.0-19.0	GP	67	29	4	.200														
		J-9	20.0-21.0	ML	7	12	81	.005														
		J-10	21.0-25.0	ML	0	12	78	.006														
FD-26	17.4	J-2	1.0- 3.8	SP-SM	0	91	9	.078														
		J-4	5.0-10.0	GW-GM	63	71	6	.150														
		J-5	10.0-15.0	GW-GM	68	25	7	.210														
		J-7	16.0-20.0	GP	49	48	3	.320														
FD-27	18.9	J-3	2.0- 3.5	SP	2	95	3	.170														
		J-4	3.5- 5.0	SM	0	84	16	.050														
		J-6	5.4- 8.8	GP	54	43	3	.150														
		J-13	20.0-25.8	ML	0	36	64	.017														

NED FORM JUL 63 510

* PROVIDENCE VIBRATED DENSITY TEST

ANSONIA-DERBY LOCAL PROTECTION

SOIL TESTS RESULTS

EXPL. NO.	TOP ELEV. FT.	SAMPLE NO.	DEPTH FT.	SOIL SYMBOL	MECHANICAL ANALYSIS				ATT. LIMITS		SPECIFIC GRAVITY	NAT. WATER CONTENT % DRY WT		COMPACTION DATA STND. AASHO			NAT. DRY DENSITY LBS/CU FT		OTHER TESTS			Organic Content %
					GRAVEL %	SAND %	FINES %	D_{10} mm.	LL	PL		TOTAL	-NO4	OPT. WATER % DRY WT	MAX. DRY DENS. LBS/CU FT	* PVD LBS/CU FT	TOTAL	-NO4	SHEAR	CONSOL.	PERM.	
FD-28	10.9	J-1	1.1- 5.0	GW	64	33	3	.290														
		J-5	15.0-20.0	ML	0	13	87	.007														
FD-29	9.8	J-1	0.0- 5.0	GP-GM	58	34	8	.150														
		J-4	10.0-15.0	ML	0	17	83	.013														
		J-10	25.0-30.0	ML	0	4	96	.004														
FD-30	10.6	J-1	0.0- 1.7	SP-SM	0	94	6	.130														
		J-2	1.7- 5.0	GP	62	34	4	.310														
		J-4	16.0-20.0	ML	0	18	82	.010														
		J-8	20.0-25.0	ML	0	12	88	.005														
FD-31	12.3	J-2	5.0-10.0	GW-GM	58	35	7	.160														
		J-4	11.6-15.0	ML	0	32	68	.013														
		J-10	25.0-30.0	ML	0	4	96	.005														
FD-32	2.6	J-1	0.0- 4.5	SP	47	49	4	.280														
		J-4	10.0-15.0	ML	0	43	57	.011														
		J-5	15.0-20.0	ML	0	41	59	.017														
FD-33	18.6	J-6	15.0-19.1	GP-GM	54	40	6	.120														
		J-8	20.0-25.0	SM	0	59	41	.020														
		J-11	30.0-35.0	ML	0	34	66	.011														
FD-34	21.5	J-6	17.6-20.0	GP-GM	56	37	7	.100														
FD-35	26.9	J-8	25.0-32.0	SP	12	85	3	.220														
		J-9	37.0-42.0	ML	0	42	58	.016														

NED FORM JUL 63 510

* PROVIDENCE VIBRATED DENSITY TEST

ANSONIA-DERBY LOCAL PROTECTIO

SOIL TESTS RESULTS

EXPL. NO.	TOP ELEV. FT.	SAMPLE NO.	DEPTH FT.	SOIL SYMBOL	MECHANICAL ANALYSIS				ATT. LIMITS		SPECIFIC GRAVITY	NAT. WATER CONTENT % DRY WT		COMPACTION DATA			NAT. DRY DENSITY LBS/CU FT		OTHER TESTS			Organic Contents %
					GRAVEL %	SAND %	FINES %	D_{10} mm.	LL	PL		TOTAL	-NO4	STND. AASHO OPT. WATER % DRY WT	STND. AASHO MAX. DRY DENS. LBS/CU FT	* PVD LBS/CU FT	TOTAL	-NO4	SHEAR	CONSOL.	PERM.	
FD-36	6.2	J-1	0.0- 4.1	GW	71	26	3	.170														
		J-3	5.0-10.0	ML	0	11	89	.004														
		J-9	20.0-25.0	ML	0	12	88	.006														
		J-11	25.0-30.0	SM	0	79	21	.038														
FD-37	6.5	J-2	0.9- 5.0	SM	0	61	39	.021														
		J-8	15.0-20.0	SM	0	58	42	.026														
FD-38	6.2	J-4	5.0-10.0	ML	0	22	78	.012														
		J-8	15.0-20.0	ML	0	12	88	.008														
FD-39	27.8	J-6	16.4-20.0	GP-GM	47	46	7	.110														
		J-7	20.0-25.0	GP-GM	48	45	7	.120														
		J-8	25.0-30.0	GP	59	37	4	.230														
		J-9	30.0-35.0	GP-GM	56	38	7	.120														
FD-40	9.5	J-2	5.0-10.0	GP	62	34	4	.260														
		J-4	15.0-20.0	ML	0	16	84	.011														
FD-41	10.7	J-6	10.0-15.0	ML	0	7	93	.004														
		J-13	26.8-30.5	SW-SM	0	92	8	.098														
FD-42	20.2	J-3	11.0-16.0	SP-SM	0	88	12	.060														
		J-5	21.0-26.0	SP-SM	0	92	8	.086														
FD-43	16.5	J-1	0.0- 5.0	GP	60	36	4	.230														
		J-4	10.0-15.0	SP-SM	6	87	7	.100														
		J-6	20.0-25.0	SP-SM	27	65	8	.100														

NED FORM JUL 63 510

* PROVIDENCE VIBRATED DENSITY TEST

ANSONIA-DERBY LOCAL PROTECTION

SOIL TESTS RESULTS

EXPL. NO.	TOP ELEV. FT.	SAMPLE NO.	DEPTH FT.	SOIL SYMBOL	MECHANICAL ANALYSIS				ATT. LIMITS		SPECIFIC GRAVITY	NAT. WATER CONTENT % DRY WT		COMPACTION DATA			NAT. DRY DENSITY LBS/CU FT		OTHER TESTS			Organic Contents %
					GRAVEL %	SAND %	FINES %	D_{10} mm.	LL	PL		TOTAL	- NO4	STND. AASHO OPT. WATER % DRY WT	STND. AASHO MAX. DRY DENS. LBS/CU FT	* PVD LBS/CU FT	TOTAL	- NO4	SHEAR	CONSOL.	PERM.	
FD-44	17.4	J-2	2.3- 7.3	GP	62	34	4	.200														
		J-4	12.0-17.0	SM	0	86	14	.060														
		J-6	22.0-27.0	SM	0	91	9	.090														
FD-45	33.4	J-6	15.0-20.0	GP-GM	58	35	7	.130														
		J-9	25.0-30.0	SM	0	83	17	.040														
FD-46	32.3	J-4	15.0-20.0	GM-GM	66	28	6	.210														
		J-5	20.0-25.0	SM	0	76	24	.040														
FD-47	34.1	J-9	25.0-30.0	SM	0	74	26	.035														
FD-48	18.9	J-5	10.0-15.0	SM	0	87	13	.050														
		J-6	15.0-18.3	ML	0	26	74	.031														
		J-8	20.0-25.0	SP-SM	0	92	8	.110														
FD-49	32.7	J-8	25.0-30.0	SP-SM	0	93	7	.110														
FD-50	32.6	J-6	20.0-25.0	GP-GM	49	45	6	.170														
		J-7	25.0-30.0	SP-SM	0	91	9	.076														
FD-51	19.4	J-3	6.3-10.0	SM	0	73	27	.042														
		J-5	15.0-20.0	SP-SM	0	93	7	.110														
FD-52	33.1	J-7	20.0-25.0	GP	48	48	4	.190														
		J-9	26.1-28.6	SP-SM	18	76	6	.140														

NED FORM JUL 63 510

* PROVIDENCE VIBRATED DENSITY TEST

ANSONIA-DERBY LOCAL PROTECTION

SOIL TESTS RESULTS

EXPL. NO.	TOP ELEV. FT.	SAMPLE NO.	DEPTH FT.	SOIL SYMBOL	MECHANICAL ANALYSIS				ATT. LIMITS		SPECIFIC GRAVITY	NAT. WATER CONTENT % DRY WT		COMPACTION DATA			NAT. DRY DENSITY LBS/CU FT		OTHER TESTS			Organic Content %
					GRAVEL %	SAND %	FINES %	D_{10} mm.	LL	PL		TOTAL	- NO4	STND. AASHO OPT. WATER % DRY WT	STND. AASHO MAX. DRY DENS. LBS/CU FT	* PVD LBS/CU FT	TOTAL	- NO4	SHEAR	CONSOL.	PERM.	
FD-53	21.0	J-4	10.0-15.0	SP-SM	42	50	8	.100														
		J-6	16.5-20.0	SW-SM	0	93	7	.100														
		J-9	25.0-27.6	SP-SM	14	75	11	.070														
		J-10	27.6-30.0	SM	0	77	23	.031														
FD-54	34.6	J-5	20.0-25.0	SP-SM	3	90	7	.110														
		J-6	25.0-28.6	SP	7	90	3	.150														
FD-55	35.5	J-7	21.6-25.0	SM	0	88	12	.065														
FD-56	20.4	J-5	15.0-20.0	SP-SM	32	62	6	.160														
FD-57	36.7	J-5	20.0-25.0	GW	58	38	4	.210														
		J-6	25.0-26.8	SP-SM	0	93	7	.120														
		J-7	26.8-30.0	SP-SM	46	46	8	.110														
FD-58	23.4	J-5	15.0-20.0	GP-GM	48	46	6	.180														
		J-6	20.0-25.0	SP-SM	46	47	7	.120														
FD-59	24.8	J-5	10.0-15.0	GP-GM	56	38	6	.150														
		J-6	15.0-20.0	SM	0	61	39	.028														
		J-7	20.0-25.0	SP-SM	37	36	7	.120														
FD-60	38.6	J-2	0.2- 5.0	GP	52	44	4	.170														
		J-4	10.0-15.0	GP	57	39	4	.200														
FD-61	33.0	J-6	18.0-23.6	GP-GM	52	39	9	.085														
		J-9	28.0-30.0	SP-SM	44	48	8	.095														

NED FORM JUL 63 510

* PROVIDENCE VIBRATED DENSITY TEST

ANSONIA-DERBY LOCAL PROTECTION

SOIL TESTS RESULTS

EXPL. NO.	TOP ELEV. FT.	SAMPLE NO.	DEPTH FT.	SOIL SYMBOL	MECHANICAL ANALYSIS				ATT. LIMITS		SPECIFIC GRAVITY	NAT. WATER CONTENT % DRY WT		COMPACTION DATA			NAT. DRY DENSITY LBS/CU FT		OTHER TESTS			Organic Content %
					GRAVEL %	SAND %	FINES %	D_{10} mm.	LL	PL		TOTAL	-NO4	STND. AASHO OPT. WATER % DRY WT	STND. AASHO MAX. DRY DENS. LBS/CU FT	* PVD LBS/CU FT	TOTAL	-NO4	SHEAR	CONSOL.	PERM.	
FD-62	25.0	J-4	10.0-15.0	GW	63	33	4	.230														
		J-6	16.8-20.0	SP-SM	6	88	6	.140														
		J-7	20.0-25.0	SW-SM	17	75	8	.110														
FD-63	32.3	J-7	11.1-15.0	GP-GM	54	39	7	.140														
		J-9	20.0-25.0	SP-SM	33	58	9	.080														
FD-64	25.7	J-3	10.0-15.0	SW-SM	12	81	7	.110														
		J-4	15.0-20.0	GP-GM	57	37	6	.170														
		J-7	25.0-30.0	SM	0	83	17	.040														
FD-65	32.7	J-7	15.0-20.0	SP-SM	32	60	8	.099														
		J-8	20.0-23.3	SP-SM	2	91	7	.090														
		J-10	25.0-30.0	SP-SM	29	61	10	.070														
FD-66	26.5	J-5	15.0-20.0	SP-SM	41	52	7	.110														
		J-6	20.0-25.0	SP	32	63	5	.190														
FD-67	32.6	J-5	10.0-14.5	SW-SM	23	69	8	.089														
		J-6	15.5-20.0	GP-GM	47	46	7	.130														
		J-7	20.0-25.0	SP-SM	0	93	7	.110														
FD-68	34.2	J-3	10.0-14.0	SM	3	81	16	.042														
		J-5	15.0-20.0	GP-GM	49	44	7	.130														
		J-6	20.0-25.0	SP-SM	16	73	11	.060														

NED FORM JUL 63 510

* PROVIDENCE VIBRATED DENSITY TEST

ANSONIA-DERBY LOCAL PROTECTION

SOIL TESTS RESULTS

EXPL. NO.	TOP ELEV. FT.	SAMPLE NO.	DEPTH FT.	SOIL SYMBOL	MECHANICAL ANALYSIS				ATT. LIMITS		SPECIFIC GRAVITY	NAT. WATER CONTENT % DRY WT		COMPACTION DATA STND. AASHO			NAT. DRY DENSITY LBS/CU FT		OTHER TESTS		
					GRAVEL %	SAND %	FINES %	D_{10} mm.	LL	PL		TOTAL	-NO4	OPT. WATER % DRY WT	MAX. DRY DENS. LBS/CU FT	* PVD LBS/CU FT	TOTAL	-NO4	SHEAR	CONSOL.	PERM.
FD-69	27.5	J-5	12.9-15.0	SP-SM	42	47	11	.060													
		J-6	15.0-20.0	GP-GM	49	44	7	.130													
		J-7	20.0-25.0	SW-SM	15	77	8	.090													
		J-8	25.0-28.2	SM	8	78	14	.050													
		J-9	28.2-30.0	ML	0	44	56	.021													
FD-70	25.0	J-5	6.9-10.0	SP-SM	19	75	6	.120													
		J-6	10.0-12.4	GP-GM	55	38	7	.120													
		J-8	16.0-17.8	SM	41	46	13	.060													
		J-10	21.0-26.0	SM	0	61	39	.030													
FD-71	16.4	J-2	5.0- 8.3	SM	0	87	13	.050													
		J-4	10.0-15.0	SP-SM	27	63	10	.065													
		J-5	15.0-20.0	SP-SM	18	75	7	.150													
FD-72	12.5	J-3	5.0- 8.4	SM	0	87	13	.070													
		J-7	15.0-20.0	SP-SM	0	93	7	.110													
FD-73	25.5	J-3	10.0-15.0	GP-GM	51	42	7	.130													
		J-4	15.0-20.0	SM	0	80	20	.040													
		J-5	20.0-25.0	ML	0	49	51	.022													
FD-74	24.5	J-3	5.0-10.0	GW-GM	58	35	6	.180													
		J-4	10.0-15.0	GP-GM	52	40	8	.099													
		J-6	20.0-25.0	ML	0	43	57	.022													
FD-75	24.8	J-5	11.4-15.0	SP-SM	43	47	10	.080													
		J-7	20.0-25.0	SM	0	82	18	.037													

NED FORM JUL 63 510

* PROVIDENCE VIBRATED DENSITY TEST

ANSONIA-DERBY LOCAL PROTECTION

SOIL TESTS RESULTS

EXPL. NO.	TOP ELEV. FT.	SAMPLE NO.	DEPTH FT.	SOIL SYMBOL	MECHANICAL ANALYSIS				ATT. LIMITS		SPECIFIC GRAVITY	NAT. WATER CONTENT % DRY WT		COMPACTION DATA			NAT. DRY DENSITY LBS/CU FT		OTHER TESTS			
					GRAVEL %	SAND %	FINES %	D_{10} mm.	LL	PL		TOTAL	- NO4	STND. AASHO OPT. WATER % DRY WT	STND. AASHO MAX. DRY DENS. LBS/CU FT	* PVD LBS/CU FT	TOTAL	- NO4	SHEAR	CONSOL.	PERM.	
FD-76	10.5	J-2	1.4- 5.0	SM	13	69	18	.041														
		J-5	10.0-15.0	GP-GM	55	39	6	.070														
		J-6	15.0-20.0	GP	48	49	3	.360														
		J-9	25.0-30.0	SM	0	60	40	.024														
FD-77	4.6	J-2	1.0- 5.0	GP	63	35	2	.280														
		J-5	10.0-15.0	GP-GM	47	47	6	.160														
		J-7	17.3-20.0	SM	0	73	27	.034														
		J-8	20.0-25.0	SP-SM	0	89	11	.070														
FD-78	3.7	J-3	7.8-10.0	SW-SM	0	92	8	.100														
		J-4	10.0-15.0	SP-SM	0	90	10	.080														
		J-6	20.0-25.0	SP-SM	0	93	7	.110														
FD-79	2.6	J-2	5.0- 7.6	GP	50	48	2	.310														
		J-3	7.6-10.0	SP-SM	0	91	9	.086														
		J-7	15.0-20.0	SM	30	52	18	.028														
FD-80	6.9	J-3	5.0-10.0	GP	55	42	3	.230														
		J-8	20.0-25.0	SM	0	71	29	.019														
		J-9	25.0-27.7	SM	0	83	17	.055														
FD-81	7.4	J-1	1.1- 5.0	GP	52	45	3	.280														
		J-6	20.0-25.0	ML	0	43	57	.009														
FD-82	31.4	J-4	10.0-15.0	SM	18	66	16	.044														
FD-83	20.5	J-3	6.7-10.0	SP-SM	16	76	8	.090														
		J-4	15.0-20.0	SP-SM	20	72	8	.089														
		J-7	25.0-30.0	SM	24	63	13															

NED FORM JUL 63 510

* PROVIDENCE VIBRATED DENSITY TEST

ANSONIA-DERBY LOCAL PROTECTION

SOIL TESTS RESULTS

EXPL. NO.	TOP ELEV. FT.	SAMPLE NO.	DEPTH FT.	SOIL SYMBOL	MECHANICAL ANALYSIS				ATT. LIMITS		SPECIFIC GRAVITY	NAT. WATER CONTENT % DRY WT		COMPACTION DATA			NAT. DRY DENSITY LBS/CU FT		OTHER TESTS			
					GRAVEL %	SAND %	FINES %	D_{10} mm.	LL	PL		TOTAL	-NO4	STND. AASHO OPT. WATER % DRY WT	STND. AASHO MAX. DRY DENS. LBS/CU FT	* PVD LBS/CU FT	TOTAL	-NO4	SHEAR	CONSOL.	PERM.	
FD-84	32.8	J-4	10.0-15.0	SP-SM	24	65	11															
		J-6	16.7-20.0	SP-SM	0	92	8	.082														
		J-8	21.7-25.0	SP-SM	24	70	6	.140														
		J-9	25.0-30.0	SP-SM	27	67	6	.150														
FD-85	35.8	J-4	10.0-15.0	GP	52	45	3	.260														
		J-6	20.0-25.0	SM	0	83	17															
		J-7	25.0-30.0	SM	4	83	13															
FD-86	38.7	J-2	5.0-10.0	SP-SM	25	67	8	.090														
		J-3	10.0-15.0	GP-GM	55	38	7	.150														
FD-87	34.4	J-2	5.0-10.0	SP-SM	27	65	8	.095														
		J-5	20.0-25.0	SP-SM	18	77	5	.140														
FD-88	26.3	J-1	0.0-5.0	SP	43	54	3	.190														
		J-4	10.0-15.0	GP-GM	62	32	6	.130														
		J-10	30.0-35.0	ML	0	12	88	.007														
FD-89	24.6	J-1	0.0 -5.0	SP-SM	43	50	7	.120														
		J-3	5.7-10.0	SM	4	75	21	.041														
		J-5	10.0-15.0	SW-SM	12	81	7	.110														
		J-6	15.0-20.0	SW-SM	14	79	7	.120														
FD-90	23.4	J-6	15.0-20.0	ML	0	26	74	.015														
FD-91	23.9	J-2	5.0-10.0	GW	56	40	4	.240														
		J-7	20.9-25.0	ML	0	35	65	.020														

NED FORM JUL 63 510

* PROVIDENCE VIBRATED DENSITY TEST

ANSONIA-DERBY LOCAL PROTECTION

SOIL TESTS RESULTS

EXPL. NO.	TOP ELEV. FT.	SAMPLE NO.	DEPTH FT.	SOIL SYMBOL	MECHANICAL ANALYSIS				ATT. LIMITS		SPECIFIC GRAVITY	NAT. WATER CONTENT % DRY WT		COMPACTION DATA STND. AASHO			NAT. DRY DENSITY LBS/CU FT		OTHER TESTS			
					GRAVEL %	SAND %	FINES %	D_{10} mm.	LL	PL		TOTAL	-NO4	OPT. WATER % DRY WT	MAX. DRY DENS. LBS/CU FT	* PVD LBS/CU FT	TOTAL	-NO4	SHEAR	CONSOL.	PERM.	
FA-1		J-1	0.0- 3.4	SP-SM	0	91	9	.078														
		J-3	3.4- 5.0	SM	0	80	20	.045														
FA-2		J-1	0.0- 2.8	SP	0	96	4	.110														
		J-3	2.8- 5.0	SP-SM	0	90	10	.074														
		J-5	5.0-10.0	SP-SM	0	90	10	.074														
FA-3		J-1	0.0- 3.6	SP-SM	0	88	12	.069														
		J-3	3.6- 4.7	SP-SM	0	91	9	.080														

A-13

NED FORM JUL 63 510

* PROVIDENCE VIBRATED DENSITY TEST

ANSONIA-DERBY LOCAL PROTECTION

SOIL TESTS RESULTS

EXPL. NO.	TOP ELEV. FT.	SAMPLE NO.	DEPTH FT.	SOIL SYMBOL	MECHANICAL ANALYSIS				ATT. LIMITS		SPECIFIC GRAVITY	NAT. WATER CONTENT % DRY WT		COMPACTION DATA			NAT. DRY DENSITY LBS/CU FT		OTHER TESTS			
					GRAVEL %	SAND %	FINES %	D_{10} mm.	LL	PL		TOTAL	-NO4	STND AASHO OPT. WATER % DRY WT	STND AASHO MAX. DRY DENS. LBS/CU FT	* PVD LBS/CU FT	TOTAL	-NO4	SHEAR	CONSOL.	PERM.	
BD-1		J-2	1.5- 5.0	ML	0	36	64	.026														
		J-3R	1.5- 5.0	ML								8.7	8.8									
		J-5	6.0-10.0	SM	28	47	25	.012														
		J-6R	6.0-10.0	SM								6.4	10.9									
		J-7	10.0-15.0	SM	38	40	22	.018														
		J-8R	10.0-15.0	SM								8.3	12.5									
BD-2		J-2	2.0- 5.0	SM	17	42	41	.0095														
		J-3	5.0-10.0	SM	22	53	25	.013														
		J-4R	5.0-10.0	SM								6.5	8.3									
BD-3		J-1	1.4- 4.0	ML	9	38	53	.0052														
		J-2R	1.4- 4.0	ML								13.7	14.9									
		J-3	5.0-10.0	SM	15	53	32	.010														
		J-4R	5.0-10.0	SM								9.7	10.7									
		J-5	10.0-12.6	SM	14	53	33	.011														
		J-7	15.0-18.7	SM	7	65	28	.018														
BD-4		J-2	5.0- 7.3	SM	37	48	15	.031				6.0	10.2									
		J-3	7.3-10.0	SM	32	46	22	.011				12.7	15.2									
		J-4	10.0-13.0	SM	18	60	22	.015				17.2	19.6									
		J-6	15.0-16.8	SP-SM	41	47	12	.041				10.6	16.5									

NED FORM JUL 63 510

* PROVIDENCE VIBRATED DENSITY TEST

ANSONIA-DERBY LOCAL PROTECTION

APPENDIX B

CURRENT COST ESTIMATE

ANSONIA-DERBY LOCAL PROTECTION

APPENDIX B

CURRENT COST ESTIMATE

CURRENT COST ESTIMATE

The total estimated cost of the Ansonia-Derby Local Protection Project is $10,844,000. A summary of the costs of the various features of the work described in this memorandum and in previously submitted memoranda are shown in Tables I and II below. A breakdown of the estimate is shown in Table III below.

TABLE I

SUMMARY OF FEDERAL COSTS

	Project Feature	Cost
09.	Channels and Canals	$ 738,000
11.	Levees and Flood Walls	6,891,000
13.	Pumping Plants	825,000
30.	Engineering and Design	795,000
31.	Supervision and Administration	690,000
	TOTAL Estimated Federal First Costs	$9,939,000

LOCAL INTERESTS FIRST COST

The estimated local interests first cost in connection with the Ansonia-Derby Local Protection Project is $905,000. A summary of the cost of the various features of the work is shown in Table II below:

TABLE II

SUMMARY OF LOCAL INTERESTS COST

	Project Feature	Cost
01.	Lands and Damages	$ 720,000*
02.	Relocations	185,000
	TOTAL Estimated Local Interests First Costs	$ 905,000**

* (1) Total land costs based on fair market value. Because local interests own a portion of the right-of-way, the estimated out-of-pocket land cost is $600,000.

** (2) Estimated local interests out-of-pocket first cost is $785,000.

(3) Other local costs, in project area for bridges replaced since the 1955 floods, total $1,444,000.

COMPARISON OF ESTIMATES

The following tabulation shows the comparison of the current cost estimate with the latest estimate as submitted in Design Memorandum No. 3, General Design and Site Geology, dated 14 January 1966.

Cost Account No.	Project Feature	DM No. 3 Estimate	Current Estimate
09.	Channels & Canals	$ 715,000	$ 738,000(1)
11.	Levees & Flood Walls	7,045,000	6,891,000(1)
13.	Pumping Plants	825,000	825,000
30.	Engineering & Design	795,000	795,000
31.	Supervision & Admn.	690,000	690,000
	TOTAL Federal Cost	$10,070,000	$9,939,000
01.	Lands and Damages	$ 720,000	$ 720,000
02.	Relocations	185,000	185,000
	Non-Federal Contributions	0	0
	TOTAL Local Interests Cost	$ 905,000	$ 905,000
	TOTAL ESTIMATED PROJECT COST	$10,975,000	$10,844,000

(1) Revision of estimate based upon the detailed studies presented in this Design Memorandum.

TABLE III

DETAILED COST ESTIMATE

	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
01	LANDS, DAMAGES & ACQUISITION (Local Interests Cost)				
	TOTAL LANDS, DAMAGES & ACQUISITION				$ 720,000
02	RELOCATIONS (Local Interests Cost)				
	30" Sanitary Sewer Siphon (incl. inlet & outlet) struct. with sluice gate)	1	L.S.	$35,000.00	35,000

02 RELOCATIONS (Local Interests Cost) (Cont)

Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
15" Sanitary Sewer Siphon (under storm drain pressure conduit in Farrel Corp. Yard)	1	L.S.	$ 1,200.00	$ 1,200
Sanitary Sewer Siphons (under Beaver Brook)	2	Each	1,500.00	3,000
Relocate Sanitary Sewer (Ansonia Manf. Co.)	1	L.S.	500.00	,500
Relocate Sanitary, Gas & Waterlines (Main St. & Beaver Brook Conduit)	1	L.S.	1,000.00	1,000
Relocate 12" Waterline (E. Bank S. of Maple Street Bridge)	1	L.S.	600.00	,600
Lower 4" gas & 6" & 8" Waterlines (Beaver Brook @ Central Street)	1	L.S.	1,000.00	1,000
Relocate 8" gas & 10" Waterlines (River St. near flood wall)	1	L.S.	12,000.00	12,000
Relocate Hydrant & Valve (@ Station 9+50)	1	L.S.	100.00	,100
Relocate 3" Gas & 8" Waterlines (3rd St. for 36" S.D.)	1	L.S.	3,000.00	3,000
Relocate 6" Gas Main & Meter House (S. of Bridge St. @ flood wall)	1	L.S.	2,500.00	2,500
Relocate Sanitary Sewer (@ R.R. Gate #3)	1	L.S.	1,500.00	1,500
Relocate 24" CI Sewer & Sluice Gate (@ R.R. Gate #4)	1	L.S.	8,000.00	8,000
Electrical Relocations	1	Job	L.S.	32,000
Railroad Relocations	1,600	L.F.	5.00	8,000
Central Street Bridge				
Structural Steel	8	Ton	400.00	3,200
Concrete (Reinf.)	126	C.Y.	65.00	8,190
Grate Deck Steel	200	S.Y.	65.00	13,000
Approach Paving	200	S.Y.	5.00	1,000
Sidewalks (8' Wide)	120	L.F.	15.00	1,800
Guard Rail	60	L.F.	5.00	300
		Sub-Total		$ 136,890
		Contingencies		22,110
		Sub-Total		$ 159,000
		Engineering & Design		13,000
		Supervision & Administration		13,000
TOTAL, RELOCATIONS (Local Interests Cost)				$ 185,000

	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
09.	CHANNELS & CANALS (Federal Cost)				
	Excavation, General	354,000	C.Y.	$ .80	$ 283,200
	Excavation, Stream Deflector	200	C.Y.	15.00	3,000
	Pumping	1	Job	L.S.	5,000
	Concrete (Reinf)	1,670	C.Y.	70.00	116,900
	Concrete (Mass)	500	C.Y.	40.00	20,000
	Steel Sheeting (Temp)	3,100	S.F.	3.00	9,300
	Stone, Riprap	19,000	C.Y.	8.50	161,500
	Gravel Bedding	11,000	C.Y.	2.50	27,500
	Gravel, Channel Prot.	6,000	C.Y.	2.50	15,000
			Sub-Total		$ 641,400
			Contingencies		96,600
	TOTAL, CHANNELS & CANALS (Federal Cost)				$ 738,000
11.	LEVEES & FLOOD WALLS (Federal Cost)				
	Site Preparation	45	Acre	$100.00	$ 4,500
	Stream Control	1	Job	L.S.	50,000
	Building Removal	1	Job	L.S.	15,000
	Concrete Removal	1	Job	L.S.	4,000
	R.R.Track Removal	1	Job	L.S.	2,000
	R.R.Trestle Removal	1	Job	L.S.	2,000
	Excavation, General	199,500	C.Y.	.80	159,600
	Excavation, Structural	92,200	C.Y.	1.00	92,200
	Impervious Borrow	250,000	C.Y.	1.60	400,000
	Impervious Fill, Comp.	160,000	C.Y.	.35	56,000
	Sand Fill Compacted	30,000	C.Y.	5.50	165,000
	Pervious Fill, Comp.	275,000	C.Y.	.35	96,250
	Random Fill, Comp.	80,800	C.Y.	.35	28,280
	Gravel Fill, Comp.	18,500	C.Y.	.50	9,250
	Filter Sand	10,000	C.Y.	2.00	20,000
	Filter Stone	5,100	C.Y.	8.50	43,350
	Crushed Stone Fill	50,000	C.Y.	7.50	375,000
	Gravel Bedding	39,000	C.Y.	2.00	78,000
	Stone Slope Protection	67,000	C.Y.	8.50	569,500
	Concrete, T-Walls	24,300	C.Y.	45.00	1,093,500
	Concrete, I-Walls	475	C.Y.	45.00	21,380
	Concrete, Conduits	3,800	C.Y.	45.00	171,000
	Concrete, Stilling Basin	800	C.Y.	45.00	36,000
	Cement	48,000	Bbl.	5.00	240,000
	Steel Reinforcement	3,626,000	Lbs.	.15	543,900

Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
11. LEVEES & FLOOD WALLS (Federal Cost)(Cont)				
Steel Sheet Piling, I-Wall	16,400	S.F.	$ 4.20	$ 68,880
Sheeting, Left in Place	70,000	S.F.	4.20	294,000
Sheeting, Pulled	7,500	S.F.	3.00	22,500
Street Gates	1,360	S.F.	85.00	115,600
R.R. Gates	1,770	S.F.	85.00	150,450
Chain Link Fence, 4 feet	200	L.F.	3.00	600
Road Gravel	2,400	C.Y.	2.00	4,800
Bit. Conc. Pavement	7,000	S.Y.	2.50	17,500
P.C. Conc. Pavement	200	S.Y.	8.00	1,600
Topsoiling	16,000	C.Y.	4.50	72,000
Seeding & Mulching	15	Acre	775.00	11,630
Storm Drains				
6" R.C.	65	L.F.	4.00	260
12" R.C.	1,723	L.F.	8.00	13,780
18" R.C.	425	L.F.	11.25	4,780
24" R.C.	1,665	L.F.	15.00	24,980
30" R.C.	1,640	L.F.	20.00	32,800
36" R.C.	1,185	L.F.	25.00	29,630
42" R.C.	1,595	L.F.	30.00	47,850
48" R.C.	2,935	L.F.	40.00	117,400
54" R.C.	755	L.F.	50.00	37,750
60" R.C.	1,975	L.F.	55.00	108,630
72" R.C.	365	L.F.	70.00	25,550
Standard Drain Manholes	55	Each	700.00	38,500
Curb Inlet	1	Each	700.00	700
Special Manholes	5	Each	5,000.00	25,000
Trench Grating Structures	120	L.F.	50.00	6,000
Plug Tailrace @ Sta. 33+00	1	L.S.	600.00	600
Reinforced Concrete Aprons	2	Each	2,000.00	4,000
Modifications to Exist. Manholes	2	Each	150.00	300
Paved Gutter	1	Each	350.00	350
Drainage Ditch & Intake Struct.	1	L.S.	3,000.00	3,000
Sluice Gate Structures				
72"	2	Ea.	25,000.00	50,000
60"	2	Ea.	20,000.00	40,000
48"	1	Ea.	15,000.00	15,000
36"	1	Ea.	10,000.00	10,000
24"	2	Ea.	5,000.00	10,000
Connect. Exist. S.D's to New Drain Manholes	15	Each	50.00	750

	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
11.	LEVEES & FLOOD WALLS (Federal Cost)(Cont)				
	Under Drains				
	6" BCCM	8,240	L.F.	$ 3.00	$ 24,720
	8" BCCM	4,325	L.F.	4.00	17,300
	10" BCCM	1,477	L.F.	5.00	7,390
	12" BCCM	1,218	L.F.	6.00	7,310
	15" BCCM	895	L.F.	7.00	6,270
	Under Drain Manholes	19	Each	250.00	4,750
	Observation Risers	49	Each	100.00	4,900
	Pressure Conduits, Storm				
	60" R.C.	1,210	L.F.	75.00	90,750
	48" R.C.	1,618	L.F.	54.00	87,370
	42" R.C.	520	L.F.	42.00	21,840
	36" R.C.	405	L.F.	36.00	14,580
	Pressure Manholes, Storm	12	Ea.	1,000.00	12,000
	Remove Exist. Utility Lines under Protection	1,670	L.F.	2.00	3,340
	Connect Exist. S D to New Interceptor S.D.	18	Each	50.00	900
	RC Barrier for Headrace at Hydro Plant	1	Job	L.S.	6,000
			Sub-Total		$5,992,300
			Contingencies		898,700
	TOTAL, LEVEES AND FLOOD WALLS (Federal Cost)				$6,891,000
13.	PUMPING PLANTS (Federal Cost)				
	River Street Station	1	Job	L.S.	$ 43,000
	Maple Street Station	1	Job	L.S.	174,000
	Front Street Station	1	Job	L.S.	235,000
	Division Street Station	1	Job	L.S.	265,000
			Sub-Total		$ 717,000
			Contingencies		108,000
	TOTAL, PUMPING PLANTS (Federal Cost)				$ 825,000
30.	ENGINEERING AND DESIGN (Federal Cost)				$ 795,000
31.	SUPERVISION AND ADMINISTRATION (Federal Cost)				$ 690,000

SUMMARY OF FIRST COSTS

Estimated Federal First Costs	$ 9,939,000
Estimated Local Interests First Costs	905,000
TOTAL ESTIMATED PROJECT COST	$10,844,000